

Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting

PUBLISHED BY MCGRAW PUBLISHING COMPANY, INC.

Volume 73

NEW YORK, SATURDAY, JANUARY 22, 1916

Number 4

The Nation's Call

WITHOUT question the greatest act of recognition of the part the engineer can play in the life of the nation was the letter written last week by President Wilson to the engineering societies, asking that their members undertake a census of the industries of the country. The plans and object of this census are discussed elsewhere in these pages. Here attention is directed merely to the importance of the President's request as marking a great step forward in recognizing the engineer's function in the nation's life. No greater tribute could be paid to the integrity of the profession than to call upon it for such a service. The work must be well and thoroughly done. It must be performed with a freedom from bias and a clearness of vision which only those of judicial temperament possess. The President professes his faith in the engineers of the country when he calls upon them for so important a service. The appointment of the Naval Consulting Board, an engineering body essentially, was a great move in advance. The industrial census plan perfects and rounds out the work of that body by bringing into the movement not merely a few representatives of the national bodies, but the rank and file—36,000 members scattered from the Atlantic to the Pacific, from the Canadian line to the Gulf. Surely the engineers of the country will respond to the President's appeal and will show that they are fully worthy of the position in public affairs which in their addresses and their society meetings they have so ardently prayed for.

Bad Liability Legislation

AN amendment, now before the committee of the judiciary of the New York state assembly, to amend the workmen's compensation law, should be defeated if medical attention for injured employees is to be secured with promptness and at reasonable expense. This amendment provides that the injured employee may select his own doctor, who will be entitled only to usual and reasonable fees. It is aimed at the "company doctor," an institution that furnishes a fruitful source of complaint for chronic objectors. While this institution is not free from abuse, it insures prompt attention, day or night, to every injury, and equal treatment to all employees. It makes possible, by guaranteeing to one doctor a rather definite volume of business, much cheaper and more efficient service. Medical supplies can be bought in quantity, and assistants and nurses employed and kept busy. The abuses of the system, in the opinion of this journal, can be remedied without throwing away these advantages,

creating endless confusion and dragging the whole matter into the courts. Such would be the effect of this amendment. A solution might be reached by authorizing the state to designate, or to approve the selection of, company doctors. This might be cheaply done by permitting the employer to make arrangements with any local doctor who had passed a simple examination before the state medical board, and disbarring any doctor against whom neglect of his contract patients was proved. The plan proposed in the assembly, however, would not secure even as good a grade of medical attendance as now obtains on contract work.

Shore Protection in Holland

TWO WEEKS AGO, in connection with a comprehensive report on shore protection for Venice, Cal., this journal pointed out the importance of the subject, and the little attention it has received. For Holland, with so much of her area below sea level, the question is vital, and here, naturally, we have some of the most elaborate protective works. A general conception of these works was given the readers of the Engineering Record by Dr. Elmer L. Corthell, the new president of the American Society of Civil Engineers, in his classic, "The War Against the Waves," in the issue of April 11, 1914. There have been developments along the Holland shore since Dr. Corthell's investigations, however, and some of these are discussed on page 118 of this issue. The discussion deals solely with groins. Most noteworthy is the recent use of reinforced concrete. In the form of beams and slabs, which are used virtually as paving blocks, they have already proved their worth. The first attempts at a more elaborate construction, using reinforced-concrete vaults and sheet piling, seem not to have been successful. The test is hardly conclusive, however, as the structures are less than six years old and are pioneer designs. Certainly the experiences in Holland should be read by all interested in shore protection.

A Memory to Be Treasured

CALLOUS, indeed, must be he who is not touched by the deep affection which has been expressed for C. C. Schneider since his death on Jan. 8. There is a sense of personal loss in the profession at large, quite different from the more or less perfunctory expressions of sorrow which are heard after the death of those who have risen to power and fame, unmindful of the interests and ambitions of those about them. Such was not Mr. Schneider's characteristic. On the contrary, he took an unusual interest in the personal and professional

welfare of his associates. He was always anxious for the success of the young men with whom he came in contact, and would never hesitate to go out of his way to assist in their advancement and in fitting them into the positions they were best qualified to fill. He did this with no expectation of return, but out of the fullness of his heart. Such characteristics always go with true greatness, nor must it be understood that his efforts for the good of the profession were confined only to such work. His influence could always be relied upon to support high standards of professional ethics, and where good "horse-sense" was needed no counsel could be better than his. Through his geniality and sterling character the technical advances he made received quickly a wide acceptance. It is not surprising, in view of all this, that there should have been a most affecting scene at the annual meeting of the American Institute of Consulting Engineers, when, after a few words of appreciation, Mr. Lindenthal called upon those present to rise and stand silently for a brief period in honor of the departed veteran. A memory such as his deserves to be treasured, for it is an inspiration to the younger men who are to maintain, and carry still higher, the standards of the profession.

Halifax Ocean Terminals

WITH THIS ISSUE begins a series of articles on the mammoth ocean terminals at Halifax. The carefully thought-out project has so many interesting features that any attempt to treat them all adequately in one issue would be futile. The originator, with his plan to make Halifax a rival of New York and Boston as a port; the designer, with his huge concrete shells for the pier and bulkhead substructures; and the constructor, with his exceptional plant for carrying out the work—all have applied their skill and daring to no small degree, and each will be featured in a separate issue. The present article is confined to the conception of the whole scheme, its aims and possibilities, the selection of the site, the main features of the project. As regards the aims and possibilities of the improvement, the Engineering Record is inclined to doubt the ability of the connecting railroads in our own United States ever to put Halifax on an equal footing with Boston and New York for mail and other transatlantic business now existing. But the development of Western Canada has just begun, and Canada is wise in taking steps to prevent the bulk of the new business from coming to the United States. Certainly the terminal plant as being constructed leaves little to be desired locally,

and the fact that the Dominion government owns the Intercolonial and National Transcontinental Railways will give the opportunity for a closer co-ordination of interests in the handling of through traffic than any United States ports or railroads enjoy. Although this journal is entirely opposed to government ownership of railroads, it believes the new port of Halifax will be well worth watching.

Instructions in Report-Writing

AS BEFITS a school which may fairly claim to be a university of technical instruction, the Massachusetts Institute of Technology at Boston has done well to provide a course in report-writing this year for about eighty junior students in the course in engineering administration. Although some engineers possess powers of written expression which are the admiration of their colleagues and the source of their increasing influence in public and industrial councils, the great majority of technical men are not natural or easy writers. As they rise in the scale above the levels of routine work, their broader success in advisory capacities comes to depend more and more upon their ability to express themselves clearly, concisely, and yet completely, in presenting or discussing problems and propositions before boards, commissions, employers and at meetings. The new course includes introductory letter-writing, followed by the investigation of matters of industrial or engineering interest, with written discussions and conclusions in both popular and semi-technical form. The use of power-driven fare boxes in the stations of the Boston Elevated Railway was one topic which was considered from several angles leading toward the determination of the applicability of this equipment elsewhere. Other subjects were an application for a position, with statement of personal qualifications; a study of the desirability of establishing a dye-manufacturing plant; and an investigation of the feasibility of an electric blueprinting outfit for the new buildings of the institute at Cambridge. The work is under the direction of an instructor in the English department, but the reports have the benefit of being criticised from the technical, as well as from the literary, point of view, through the co-operation of other members of the staff.

Resignations in Coast Survey

IN his annual report for 1915, E. Lester Jones, superintendent of the U. S. Coast and Geodetic Survey, calls attention to the number of men who resign each year, "just when they have reached a high standard of efficiency." In answer to his own question as to what is wrong with the service under existing conditions he says in part: "The service offers a future so unattractive that few men, when they learn what is in store for them, have the courage to continue in it. The dangers and hardships endured, the sacrifices made, are out of all propor-

tion to the rewards received. The men must devote the best years of their life to the service in all parts of the United States, Alaska and the Philippines, must go to sea in small craft, and at the risk of storms and unknown dangers—must give up the home life, which every man sooner or later desires, and must endure hardships and discomforts inseparable from the work of the service. They receive during the period of their greatest efficiency a moderate salary, hardly sufficient to meet present needs." Such being the case the wonder is that there are not even more resignations. Hardships and discomforts, in the earlier years are almost a part of the average engineer's life, and the type of man who enters the profession generally expects to encounter them. But in any service he has a right to expect compensation that is in some degree proportionate to the kind of work he is doing and to the amount of hazard involved. A salary that barely equals his present needs can hardly be called just compensation. Mr. Jones urges that the employees of the service be assured of a small competency in old age, when unfit for field duty. The logic of pensioning engineers when they are no longer able, physically, to endure hardships and exposure is not, at the present time, generally conceded, though many governing bodies and excellently managed corporations have adopted the practice. The question of compensation, however, has been fully threshed out. It is generally conceded that "the laborer is worthy of his hire." If the men in the Coast and Geodetic Survey are not being paid for their services at a rate approximately equal to what they would obtain for similar work, under similar conditions, with private firms, the situation should be remedied, and at once. The government should not be a laggard in matters of just payment for services rendered.

Taking a Census of Industry for Preparedness

THIS journal has taken occasion since the commencement of the great European conflict to point out, several times each month, the engineering aspects of modern warfare. It has clearly demonstrated by a dozen or more editorials the part that the engineer must take, and is taking, abroad, in military affairs. Latterly, too, it has devoted an unusual amount of space to the place of engineers, contractors and the industries in any adequate preparation for national defense. These ideas, little appreciated at first, are daily meeting increased support from technical men, so that now the profession is ready to respond at once to any call which the constituted authorities will make. That such calls will come is clearly shown by the request made by the President of the United States last week that the national societies of civil, electrical, mining and mechanical engineers and chemists bear the burden of making an industrial census of the country. The purpose of the census is to organize

the industries for national defense.

Of course, the profession has already been called upon for assistance in connection with the preparedness movement. The Naval Consulting Board is an engineering body, while a joint committee of engineers has prepared a bill for the formation of an officer's reserve corps, the provisions of which have been incorporated in the administration's preparedness program. These activities have, necessarily, been participated in only by one or two representatives of each of the societies. The proposal of the President, as elaborated by the Naval Consulting Board, will call into the work members of the societies in every state of the Union. In fact, a goodly number of the great total of 36,000 members will find themselves drafted, ere long, for the work of preparing the needed information regarding their own plants or of collating the data furnished by their professional brethren.

The purpose of the census is to learn the characteristics, equipment and capacity of every plant in the country, large and small, which can be used to manufacture supplies needed in military operations—for the transportation, subsistence and equipment of an army. Evidently, though, this is only the first, even if the most necessary step. As explained in the *Engineering Record* of Nov. 13, 1915, page 589, in connection with the Gillen plan for organizing industries for defense, after it is known what plants are available and what can reasonably be expected of them, the next move will be to inform the manufacturers in turn as to the kind and quality of product which the government would need. Details of this subsequent procedure have not yet been developed, but the plan of letting small contracts for the supplies in question, so that the plants may have actual experience, has such merits that it will undoubtedly be adopted.

The procedure proposed for the census is to ask each of the societies addressed to appoint one representative in each of the states of the Union. These five men in each state will form a central board which will request the members of the profession in that particular commonwealth for the information needed regarding their plants and those in their vicinity.

Obviously, technical men, thoroughly familiar with quality of products, characteristics and capacities of equipment and tools, are exceptionally well qualified to record industrial conditions. One need only to advert to other possible alternatives to see the advantages of the scheme which has been adopted. Under one plan, form letters might be sent from a central office in Washington to the manufacturers of the country requesting specific information. Another scheme would be to hire a body of men to go from place to place and collect the needed data. Both of these alternatives have very evident disadvantages. Technical questionnaires seldom are thoroughly answered, because of the difficulty of conveying to the non-technical mind of the man in charge of a plant the character of the inti-

mate information needed. On the other hand, the plan of having personal investigators would involve a tremendous expense, would necessarily send to many plants investigators unfamiliar with the industry in question and would be exceedingly slow.

It is not surprising, then, that the engineers of the country have been enlisted in this most necessary and most patriotic service. With the guidance of the very able men constituting the committee on production of the Naval Consulting Board the plan should prove a success.

Qualifications for Tunnel Men

IN this issue S. P. Brown concludes his series of three articles on the economic possibilities of tunnel drill carriages by describing unique types of carriage for bench and for trimming work, and telling how they effected a substantial saving in the cost of driving the Mount Royal bore for the Canadian Northern Railway in Montreal. The case of the drill carriage has been presented so completely that there is no need of an elaborate summing up. Obviously, drill carriage methods cannot be employed successfully in every tunnel; the character of the ground and the system of excavation must be such as to justify them. Then, too, it is necessary to decide whether the plant investment in drill carriages will yield an adequate return, and this consideration, of course, depends upon the length of the tunnel and the important factor of speed. No two cases in tunnel driving are alike and each must be studied as an individual problem. In its proper place, however, the drill carriage has proved its claim to recognition.

But the proper selection of mechanical equipment is only one feature of successful tunneling. Men are fully as important as methods. There is no scarcity of engineers and superintendents who can drive tunnels, but the men who can do it economically and expeditiously are rare. Alignment work is comparatively simple and direct, requiring mainly patience and accuracy. Tunnels have been driven successfully, in this respect, from opposite ends and intermediate shafts, for thousands of years. It is in the final court of actual costs that the really skillful tunnel man appears.

Not only must this man be conversant with the diverse methods of tunnel driving commonly used in different parts of the world, but he must also be intimately familiar with the detailed and different methods of drilling, blasting, mucking, timbering, shield operation, etc., that the individual case may demand for its most economical prosecution. All this, too, is so closely affected by the material at hand—men, materials of construction, plant, geological formation, etc.—that his judgment must be unusually sound and agile. He must not only be able to judge wisely as to the best general method to be adopted in the beginning but also be ever ready to change and modify this method promptly when emergencies arise; and this must result in the greatest economy and least confusion of the work and organization.

The primary ability of such men is, of course, inherent in them, although the intimate knowledge of the details of the work can only be had by experience in "the hole." The knowledge of systems and methods used under different general conditions may, to a certain extent, be obtained from books, although the number of tunnel books worth reading is distinctly limited. The greatest source of really useful and constructive information is the engineering press and the proceedings of the various engineering societies.

It is not the generally descriptive article that the experienced engineer finds useful. What he wants is detail—how obstacles were overcome; how unusual economies were obtained; what the economical result was, resulting from a sudden change of plan; why a certain system of drilling and blasting was used which normally would have broken the rock irregularly, increasing both the quantities of excavation and masonry. This is what the engineer should get in engineering literature. It is, however, regrettable that more of the really eminent and actively successful tunnel engineers do not publish such data. The exchange of opinion, experience, and discussions would greatly aid the profession as a whole, and help develop a class of men now rather hard to find in the engineering field.

Significant Features of New York's New Building Code

NEW YORK'S new building code, the completion of which was noted editorially in this journal Jan. 8, has been acclaimed the best code in the country. Rightly much attention has been given to the procedure by which this very desirable result was secured. The adoption of a code at a cost of only \$15,000, when \$200,000 had been spent in three previous unsuccessful attempts naturally attracts unusual attention, while the intrusting of the revision to a single individual is a radical innovation, as municipal and government matters generally are carried on to-day. So fortunate, however, was New York City in the selection of Rudolph P. Miller to carry on the work, and in the system of hearings preceding the final adoption, that even the opposing commercial interests have been well satisfied, while competent engineers who have followed the matter are loud in their approval of the purely technical features of the code. For these reasons, and the further one that the new document escapes the damning accusation, visited on its abortive predecessors, of being a "specification" code, both the document itself and the procedure become models which will be followed by other cities.

The document being of such high worth, it is appropriate to sum up briefly its significant features. In addition to marked improvement in arrangement and logical subdivision, with resulting ease of reference, there are technical features of more than passing interest to engineers. One of the most radical of the changes was commented upon in this journal in an editorial June 5, 1915, when the new formulas for the de-

sign of fire-resistive floor slabs of concrete between steel beams were discussed. It was pointed out that the coefficients given, which have been fixed as conforming to the results of previous tests and the prevailing practice based thereon, imply bending moment coefficients which are much lower than those required in standard concrete floor design. One laudable object thus obtained, however, was the placing of cinder concrete and terra cotta upon a fair comparative basis—a result which had never before been possible of accomplishment.

The treatment of standard reinforced concrete design is entirely in accord with the best practice. Greater definiteness and exact limitations are found in the new section covering specifications for materials, and in the section on projections beyond the building line. A notable characteristic traceable throughout the new code is the successful attempt to increase the safeguards against fire and danger of loss of life, due to fire. The latter important requirement is attained through the use of a new basis for the requirements for exits and stairways. These are determined by the number of persons per floor, and are made less severe when sprinkler protection is furnished. By specifying the number of stairways and the limiting distances which are allowed between exits and the remote parts of a floor, basing width of stairways upon number of persons, and the number of persons upon rules according to class of occupancy, the rapid emptying of such buildings as hotels and apartment houses is made possible. Fire-resistive walls are required around stairways in buildings over 40 ft. in height and fire escapes must be designed for 100 lb. live load.

In the article on strength of materials, the live floor loads are modified somewhat and the allowable working unit stresses made to conform more nearly to the usual standard practice, so that, on the whole, no radical change in the design will result. A concentrated load of 4000 lb. at the center of beams is specified as a possible alternative loading. The field of use for hollow tile partitions is extended. In the article on foundations a new provision is found in sections specifying allowable stresses for three classes of concrete piles.

Among the new general requirements is the regulation which forbids the use of any new building before a certificate of occupancy has been issued by the superintendent of buildings, stating the nature of use or occupancy, the allowable floor loads, the number of persons per floor, and that all requirements in the code have been met. No change in occupancy of a building will be permitted without a new certificate from the superintendent. The regulation allowing the amount of the fine for violation to be fixed, within certain limits, by the superintendent of buildings may be criticised as tending to give the latter a power which he might use unjustly. A drastic revision makes it a misdemeanor to continue violation of a peremptory order issued by the superintendent because of danger to public health or safety. In view of recent events this provision is urgently needed.

Ocean Terminals Under Construction Expected to Make Halifax an Important Port

Project Involves Piers 1250 x 340 Feet in Water Up to 45 Feet Deep, Together with 6-Mile Connecting Railway—Cellular Design for Concrete Bulkheads

POSSESSING in the city of Halifax the most easterly established seaport in North America, a point a good day's journey nearer Europe than New York is even by the fastest steamships, the Canadian government is preparing to make a determined bid for the new trans-Atlantic traffic to be created by the Canadian transcontinental railways, if not for some of the older business now conceded to belong to New York or Boston. Heretofore, however, both the terminal facilities at Halifax and the railway connections have been inadequate to handle any considerable amount of business. Following an extensive investigation made in 1912 and 1913 as to the exact site and type of construction, work is now well advanced on the first unit of a large and modern steamship terminal on the south side of the city together with a 6-mile railroad passing around west of the city and connecting with the Intercolonial Railway on the north. The terminal, like the harbor, will accommodate the largest boats afloat. It will also, it is believed, with the facilities proposed, be one of the most convenient in the world for the transfer of passengers and cargo. Completion of the Quebec bridge and the contemplated improvement of the Dominion-owned Intercolonial Railway together with the New National Transcontinental Railway will give the port excellent direct connections with the West, and may even reduce the time for mails between Europe and New York. From the technical point of view the project has added interest because the piers are 1250 ft. long and 340 ft. wide and upward, because they are in water up to 45 ft. deep, because an original cellular design has been adopted for the concrete bulkheads and quay walls, because unusual equipment has been developed to cast and place these "shells," as they are called, and because the whole scheme has been so worked out that despite a large

amount of wet and dry excavation there will be little borrow and no waste of material.

HALIFAX AS A PORT

The geographical advantages of Halifax are shown on the accompanying map of eastern Canada and the United States. As compared with New York the port is 539 miles nearer England by the northern route and 477 miles by the longer southern route. The harbor and approach channel are from 50 ft. deep upward. While well protected from the elements, the harbor is close to the open sea, and harbor and channels are so wide and easily navigated that the largest ships can enter, turn around and leave by their own power, at all hours of night or day. Also, the harbor is open all the year around. The Intercolonial Railway extends from Halifax to Moncton, N. B., where it forks one line going to Levis, opposite Quebec, near which point it will ultimately connect with the Quebec Bridge, the other line going southwest to St. John, where it connects with the Canadian Pacific and thence with the Maine Central, Boston & Maine and New York, New Haven & Hartford to Boston and New York. At Moncton the Intercolonial also joins the government-owned and operated National Transcontinental Railway, which, with its light grades and excellent roadbed gives direct connection to Winnipeg and the Canadian West.

These are the main advantages of the port. The chief disadvantages are that the existing piers are inadequate and do not lend themselves readily to expansion; that the local railroad facilities are cramped; that the port depends on one railroad, which is not yet fully equipped to handle very heavy traffic; and that the connecting railroads reaching toward Boston, not owned by the Dominion government, are likewise not well equipped for heavy traffic and fast service. Consequently Halifax has never

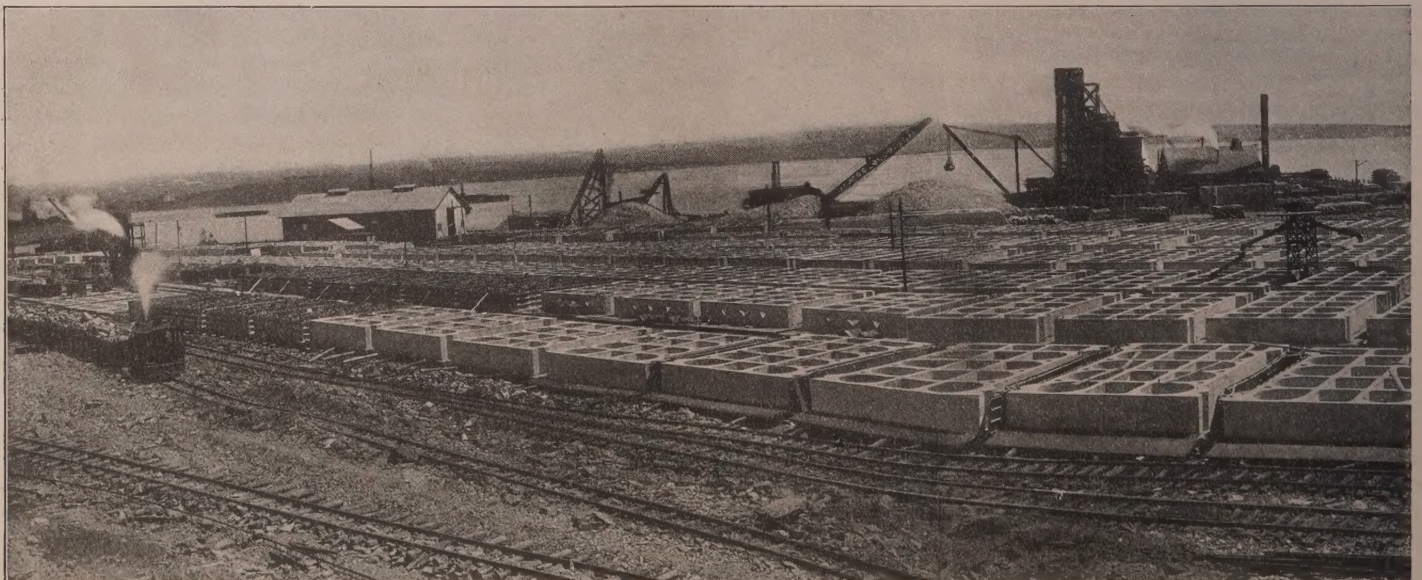
for long been able to compete successfully with other American ports.

All things considered, no other Canadian port is better equipped than Halifax to compete with the ports of the United States. Consequently, with two new Canadian transcontinental railways under construction and practically completed the Dominion was confronted with the likelihood that the bulk of the foreign business created by these lines would pass through the ports of the United States. A government investigation was instituted in 1912, therefore, to rectify conditions so far as possible and put Halifax in a position to take care of the new business. Incidentally, as plans had already been developed for improving the Intercolonial Railway, it was seen that the running time for mails by railroad from Halifax to New York could be so cut as to give Halifax the advantage over the all-water route between New York and Europe.

FOUR SITES FOR TERMINAL CONSIDERED

The first question taken up in the 1912 investigation was the site for the proposed terminals. Four schemes, A, B, C and D were considered.

Scheme A embraced the existing facilities and extended on both sides of them with accommodations for twenty-six large steamships. (Pier 2, under construction at the time of the investigation, was described in the Engineering Record of June 13, 1914, page 662.) This scheme had a central location and existing railroad facilities. It would have required condemning the principal businesses in the city, however, and driving them to a new location, and it would have necessitated the removal and reconstruction of the naval dock yard on another site. During the construction both railway and ocean traffic would have been hampered, and this traffic would in turn have hampered the construction work and delayed its execution. The railway ap-



OF FIVE DESIGNS CONSIDERED FOR THE SUBSTRUCTURES OF THE HALIFAX OCEAN TERMINALS, STACKS OF CELLULAR REINFORCED-

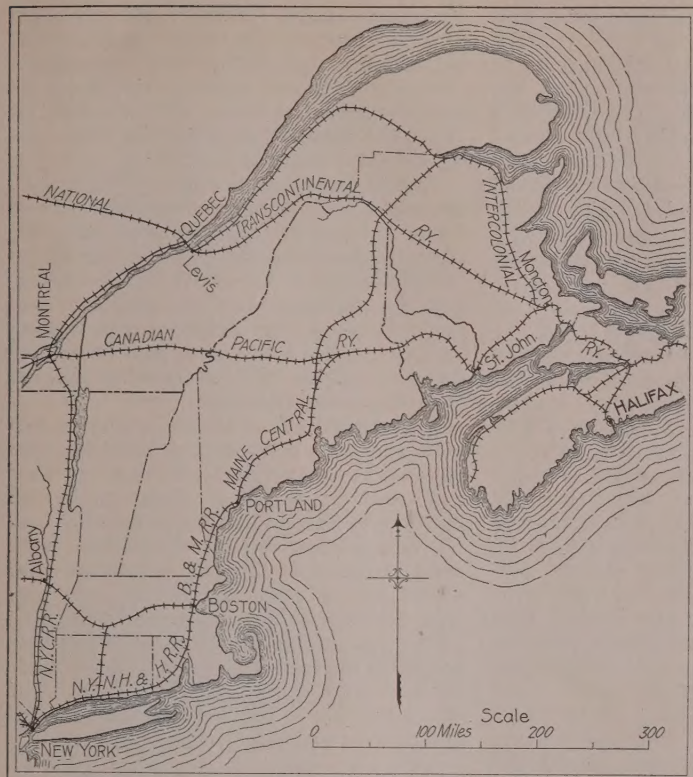


FIG. 1—HALIFAX AND HER RAILROAD CONNECTIONS TO THE WEST

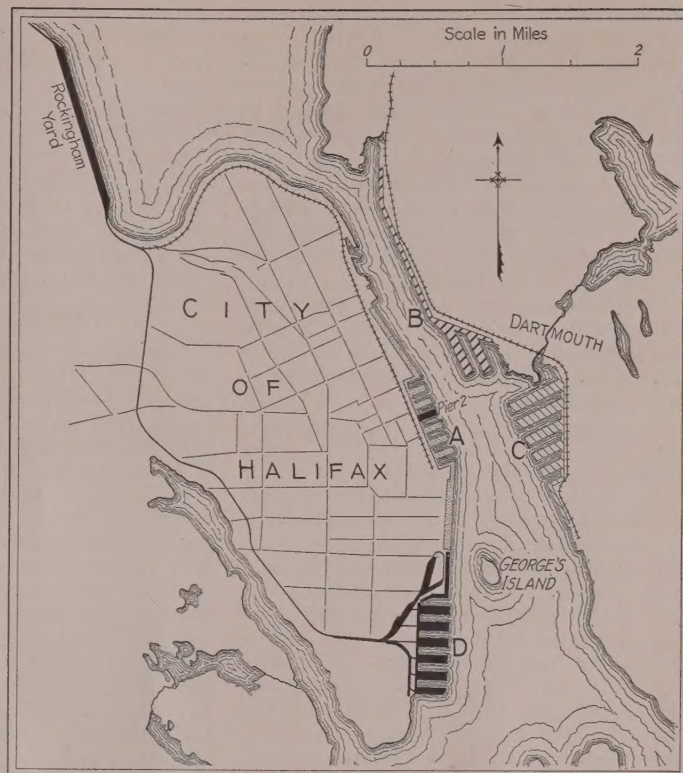


FIG. 2—THE FOUR SITES STUDIED, AND THE CONNECTING RAILWAY

proach, furthermore, was unsatisfactory. The scheme would have been the most expensive of the four, the estimated cost being \$1,235,000 per berth, this figure including land, quays, sheds and equipment.

Scheme B, on the opposite side of the harbor, from Tufts Cove to Dartmouth, would have afforded accommodation for twenty-four steamship berths. Land and construction would have been comparatively cheap, no extensive existing business would have been dislocated, and there was an existing railway connection which could have been made very good. The main disadvantage of the scheme was that it was without convenient access to the city, and the investigators had found that no harbor removed from the business-center of a city had ever been made successful. Furthermore, extensive improvement of the railway would have been necessary, duplicate train service

would have been required to the ocean terminals and to Halifax, and difficulty would have been experienced in maneuvering and turning ships in the Narrows. This scheme it was estimated, would have cost \$800,000 per berth.

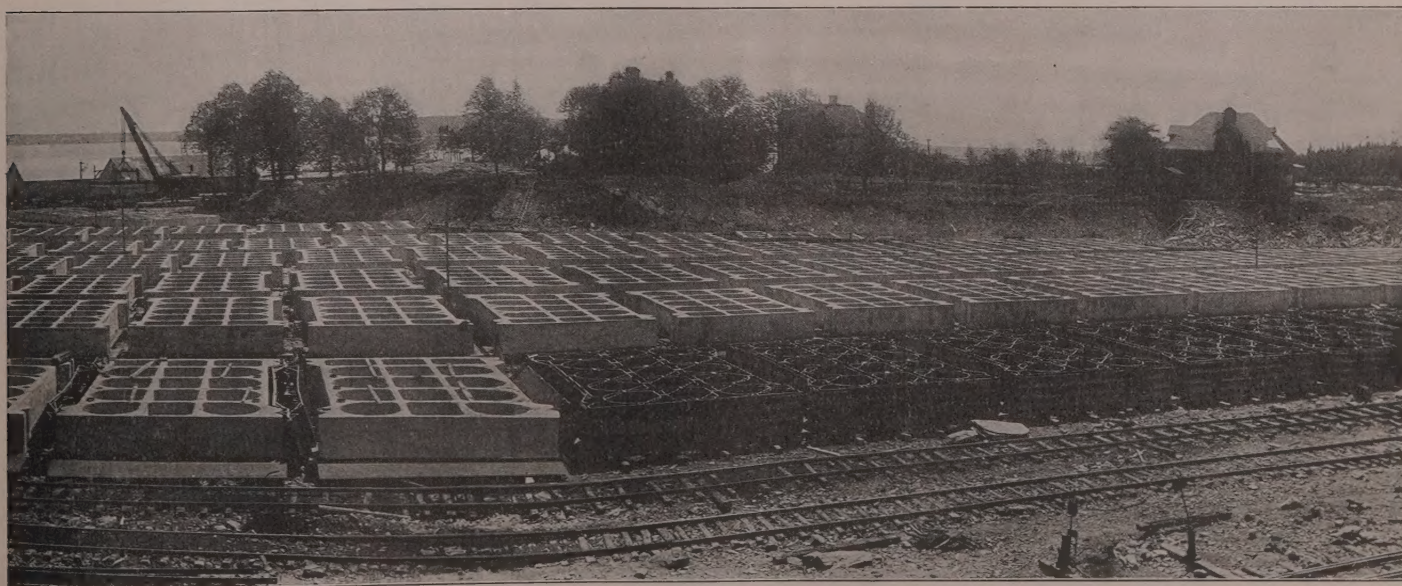
Scheme C, would also have been across the harbor from Halifax, south of Dartmouth. It would have been a little larger than scheme B, giving accommodations for twenty-eight steamships and costing \$880,000 per berth. Its advantages and disadvantages were much the same as those of scheme B.

PLAN ADOPTED

Scheme D, the one adopted, is located on the Halifax side of the harbor, south of the business center and George's Island. It has many advantages. The union passenger station and steamship terminals are

located very close and convenient to the center of the city. The passenger landing quay is of the bulkhead type, facilitating the docking and departure of ships, and is located on a part of the waterfront where pier construction would not be permissible on account of George's Island, which island, however, protects the site from north and northeast winds, and leaves a deep-water channel at least 800 ft. wide. It is believed that this landing quay will provide the safest and most rapid exchange between steamships and railways of any port in the world.

The scheme utilizes a part of the city waterfront hitherto little developed. The piers will be of uniform length, and owing to the great width and depth of the harbor opposite them the maneuvering of the largest ships and their access to the pier berths will be attended with unusual facility.



CONCRETE SHELLS WERE CHOSEN—THE SHELLS ARE CAST IN A LARGE YARD ON THE SITE OF THE FUTURE RAILROAD YARDS

While a new railroad connection had to be built, this has been so located around the west side of the city as to give ample facilities, which the existing lines could not do.

The only disadvantages established up to the present time are that the new railway passes through a high-class residential section, and that the terminals will encroach to a certain extent on Point Pleasant Park. Care is being taken to minimize these disadvantages by artistic treatment of the railroad slopes and bridges.

This scheme gives berthing space for twenty-seven steamships, at an estimated cost of \$860,000 per berth. The scheme is progressive and lends itself to extension as conditions demand.

GENERAL SCHEME OF TERMINAL

Fig. 3 shows the general scheme of the terminal, as at present planned; the details are subject to change. On the north nearest the business district of the city, is the landing quay for passengers, baggage and mail. South of this, at right angles to the shore line, will be five full-width piers, and beyond the last one will be a combination breakwater and narrow pier. Extending across the end of the tracks from the north end of the quay shed will be the railroad concourse and station. Alongside the passenger terminal will be the passenger coach yards, parlor, sleeping and dining car department buildings, and central light, heat and power plant. Yards, engine house, grain elevator and subway under tracks will be located as shown. The main freight terminal yard will be on land reclaimed from Bedford Basin at Rockingham, shown on Fig. 2, where the new railroad connection leaves the present Intercolonial Railway. The main engine house will also be located away from the terminal, that shown in the plan being for yard engines only.

Only the steamship facilities shown in full lines will be built at the present time,

although most of the core filling for pier B has been placed from material obtained from the grading of the yard opposite, to form an additional breakwater until the remaining piers are built. The immediate construction will accommodate nine steamships, the plan being to build two more piers in three or four years when better railroad facilities have been provided, and to finish the project three or four years after, that when the Quebec bridge is in service and traffic has been developed.

PASSENGER FACILITIES

The movement of passengers between trains and ships has been fully separated from the handling of baggage, mail and express. The passenger landing quay will be 2006 ft. long, with the principal passenger and immigration building, which is about 600 ft. long, located at the north end directly connected with the railway passenger station, trainshed and baggage rooms. The remainder of the quay will be surmounted for its full length by a two-story building 116 ft. wide. The ground floor will be used for freight and the upper floor for passengers, baggage, mails and express, and also for freight when required. From the north end of this building the two-story train-concourse building will connect over the track and paved roadways to the city station building, which will front on Hollis Street and a large open square or plaza. The upper floor of the concourse will be used exclusively by passengers, the baggage and express being lowered to the first floor by elevators in the quay building. This arrangement will permit the examination of baggage by the customs officials on the second floor of the quay building in the presence of its owners. The ten tracks in the trainshed will be located singly, with passenger and baggage platforms alternating between them. From each platform a ramp will lead up or down as the case may

be to the baggage floor or the passenger level. Thus nowhere in the short journey between boats and trains will the passenger encounter baggage trucks. The platforms will have lengths up to 1000 ft. and the trainshed roof will be after the Bush type of steel and concrete.

Part of the upper stories of the principal passenger building will be divided into separate quarters for United States and Canadian immigrants and customs and immigration officials. By means of tracks alongside the passenger and immigration building at the quay level mails, express, freight, baggage and immigrants can be loaded direct on trains without passing through the train concourse proper.

There will be four 600-ft. berths to each pier, and each berth will be provided with its own two-story steel and concrete shed and facilities, including railway tracks and platforms, and independent railway connections for switching cars, together with team entrances and ramps, so that the operations at any berth will not be interfered with by those at any other berth adjoining or opposite. The lower floors of the sheds will be at the car-floor level and will be used for outbound or ocean-going freight, while the upper floors will be used for inbound freight and outbound passengers.

SUBSTRUCTURES

Much study was given to the question of material and design for the pier and quay substructures. The activities of the teredo and limnoria, together with heavy maintenance and fire risks, made timber practically out of the question, while on the other hand much trouble has been experienced with concrete in these waters by spalling within the range of the tides, due to the combined action of sea water and frost. The investigators concluded, however, that the frost action could be eliminated by proper construction.

The following five types of design were studied at considerable length: (A) A block-work facing with a mass-concrete heart; (B) a series of reinforced-concrete caissons 110 ft. long, filled with concrete; (C) solid concrete block work; (D) a reinforced-concrete deck supported on concrete cylinders, and (E) stacks of cellular rein-

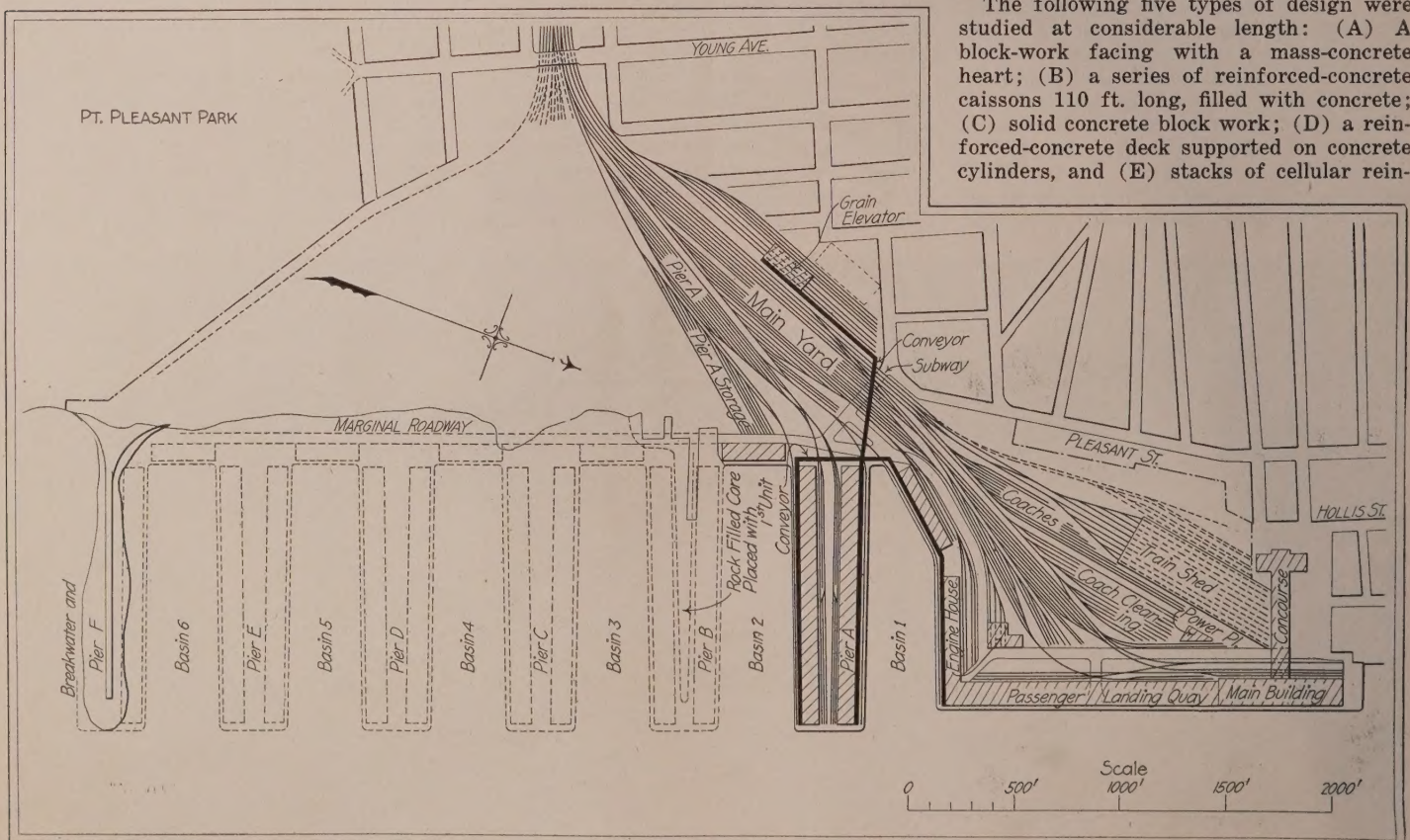


FIG. 3—IMMEDIATE AND ULTIMATE DOCK CONSTRUCTION, AND SUCH OF THE TRACK WORK AS HAS BEEN SETTLED UPON

forced-concrete shells, placed one above the other and securely bonded and bedded by means of mass concrete and grout in some of the compartments, the other compartments being filled with rock or other material. The last type was adopted. The reasons why, the theoretical analysis of the design, and the unusual plant developed to handle the construction efficiently will be discussed in subsequent articles.

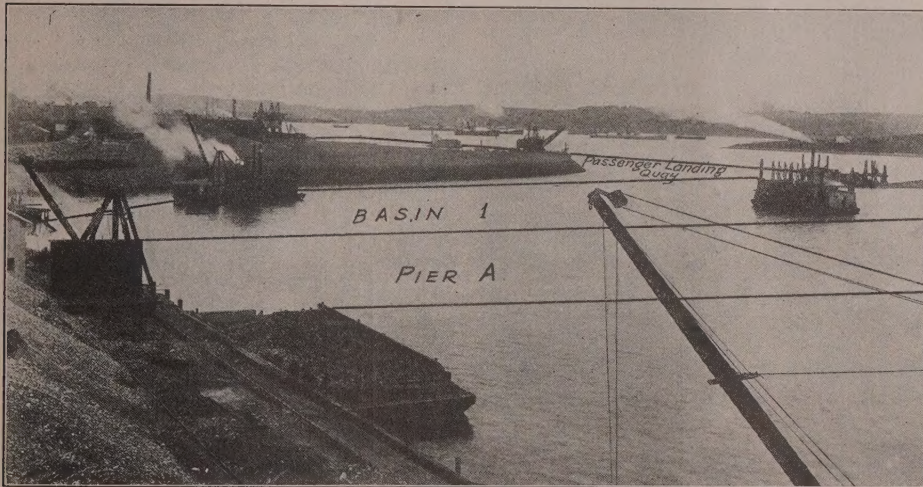
LITTLE WASTAGE OF EXCAVATED MATERIAL

As stated in the first paragraph, there is practically no wastage of excavated material and very little borrow. Material dredged from the basins is placed in the adjoining piers, as is that excavated from the yards opposite. The railroad connection, especially at the terminal, requires a large amount of excavation, providing

Butt Treatment of Piles and Poles Effective

Vulnerable Parts as Well Protected as by
Creosoting Entire Piece—Painting or
Dipping Only Makeshifts

BUTT TREATMENT under pressure of only those parts of poles and piles especially subject to rapid decay was proposed by Frank W. Cherrington, at the wood preservers' convention in Chicago this week, as a suitable and economical substitute for the treatment of the entire piece. While he holds that the creosoting of poles and piles in their entirety is an economical investment, he believes that a butt treatment with pressure by means of a vertical cylinder would be effective, whereas dipping or painting are only makeshifts.



A GLIMPSE OF HALIFAX HARBOR AND PART OF THE SITE AS IT APPEARED JUNE 24, 1915
Outlines of new works indicated.

material for the main yard at Rockingham, which will be partly on low ground along the waterfront, but for the most part on land reclaimed from Bedford Basin by filling. The yard west of piers C, D and E will not be built at the present time, but a track has been graded for hauling the materials from the railway cuttings for the construction of the breakwater, which consists of rock fill protected with rough blocks of rocks weighing from 5 to 10 tons each.

The improvement is being carried out under the Hon. Frank Cochrane, minister of the Department of Railways and Canals, of Canada. F. P. Gutelius, general manager of the Canadian Government Railways, is in general charge of the whole project, and directs and supervises its construction. Frederick W. Cowie, chief engineer, Montreal Harbor Commissioners, and C. B. Brown, chief engineer of the Canadian Government Railways, are consulting engineers on the dock and railroad works respectively. James McGregor is superintending engineer at Halifax, in direct charge of design and construction. A. C. Brown is the resident engineer on the dock works, for which Foley Brothers, Welch, Stewart & Fauquier are the contractors. The Cook Construction Company, Ltd., and Wheaton Brothers are building the railroad connection, on which R. H. Smith is resident engineer. The architects for the passenger station and immigration buildings are Ross & Macdonald of Montreal.

[The construction features of the Halifax Terminal work will be described in another article to be published next week.—EDITOR.]

shifts. His remarks before the convention were in part as follows:

Many engineers would more generally specify creosoted piling and poles for structural purposes if it were possible efficiently to creosote under pressure, at low cost, only those parts of such materials as are exposed to rapid decay. The city of Chicago, for instance, although now using creosoted piling of necessity, pays for creosoting the entire length of the pile, when about 75 per cent will not be exposed to decay. About 30 ft. of a 45-ft. pile is constantly submerged beneath the river and would never decay, while about 12 ft. only protrudes and is subject to deterioration, unless creosoted. Piling and sheeting below the water are always in perfect condition, unless the water is infested by marine borers.

TREATMENT OF ENTIRE PIECE BEST

Beyond question the most efficacious method of treating any timber is by using some process employing a hydraulic pressure to insure a thorough penetration of the preservative throughout the wood volume. Penetration is essential to the permanence and effectiveness of the treatment, and without pressure, maximum penetration may not be secured. Any superficial coating of preservative oil upon the surface of the exposed portion of the timber, such as painting with a creosote or carbolineum, or dipping a part of the timber in the preservative, are at best but temporary expedients. Therefore, any process which may do away with makeshift treatments, and place the butt treatment of

poles and piling upon a scientific, economical and efficient basis, deserves careful consideration.

From the above data it is seen that a thoroughly creosoted butt treatment of the woods now generally used and treated in their entirety, to protect the piles or poles at the wind and water or the air and ground lines, respectively, should give very satisfactory results. Especially in more northern climates where that part of the timber above the ground line of poles, and below the water line of piling, seldom if ever decays.

Until recently engineers have considered it impractical as well as impossible to treat, by the injection of creosote oil under pressure, the butt only of piling or telephone poles. The writer understands that there is now in process of development at least one practical means of accomplishing this long-sought end, by providing a vertical cylinder for injecting by any standard process, any required amount of preservative into the butts only of piling or poles, while the upper parts of the timbers are merely surrounded by the compressing medium air.

WHAT PROPER BUTT TREATMENT MAY ACCOMPLISH

Such a butt treatment of piling or poles with pressure by means of a vertical cylinder would accomplish the following results:

1. It would place the butt treatment upon a strictly reliable and scientific basis.
2. It would permit more than a mere treatment of the sap wood.
3. It would place under control the amount of creosote injected per cubic foot of timber.
4. It would allow any desired process of preservative treatment to be utilized at the butt only of a pole or pile.
5. It would reduce the cost of pressure treatment without reducing the efficiency of preservation, as the same penetration of preservative is secured at the vulnerable air-and-water line, or air-and-ground line portion, as if the entire timber is treated under pressure.

Creosoted piling and poles treated in their entirety are an economical investment. And a lower-priced, equally efficient means of treating only these parts of such timbers so susceptible to rapid decay should, upon perfection, accelerate the adoption of creosoted piling and poles on a much larger scale.

Light-Soil Roads Not Suitable for Traffic Unless Surfaced

WHEN highway traffic exceeds 2000 tons per year on roads constructed of light soil it is time to adopt some form of hard surfacing, according to a statement by A. P. Anderson, highway engineer, office of Public Roads and Rural Engineering, in the *Reclamation Record*. Dragging many of these roads has not the cumulative effects, such as obtain on clay roads, as the only binding power is the capillary moisture lost when the road gets dry. The maintenance must be directed toward retaining the moisture by incorporating with the surface soil some natural binder, such as clay or adobe, or adding some temporary fibrous binder, such as straw or sage brush. In irrigated districts flooding is worth considering, one side at a time, or, where the rate of lateral percolation is rapid, flooding the side ditches.

High Unit Pressures Found in Experiments on Distribution of Vertical Loading Through Sand

Results Indicate Practically No Decrease in Maximum Intensity of Pressure with an Increase in Bearing Area

By MELVIN L. ENGER

Assistant Professor of Mechanics and Hydraulics, University of Illinois, Urbana

RELATIVELY high intensities of unit pressure directly under the loads have been observed as the result of a series of experiments made at the laboratory of the University of Illinois for the purpose of determining the distribution of vertical pressure as it is transmitted through sand. The effect of the size of the area of appli-

cation of the applied load the loading device was shifted to any desired position.

In the apparatus used in the earlier experiments the sand rested on a plank floor laid on closely spaced I-beams, but the results were not entirely satisfactory. It is thought that the yielding of the floor had a considerable effect upon the distribution of the pressure.

CONDUCTING THE EXPERIMENTS

In most of the experiments the load was applied to the sand through a circular plate 13½ in. in diameter. The load was applied by means of a hydraulic jack which

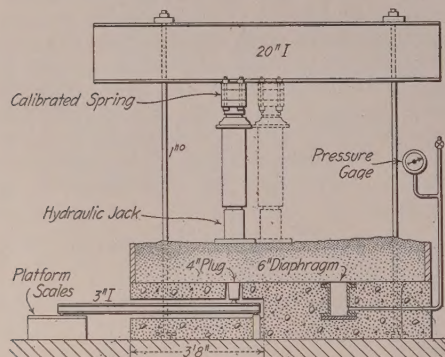


FIG. 1—ARRANGEMENT OF APPARATUS

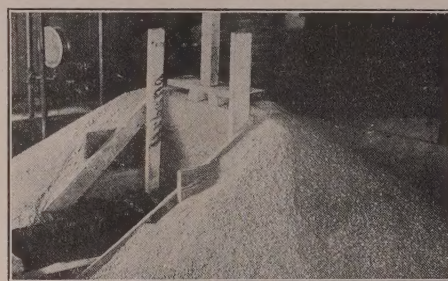
cation of the load upon maximum pressure is found to be much less than is usually assumed. The pressure on any horizontal plane is found to be far from uniform, and photographs of actual sand movement under load have been taken to picture the direction of pressure distribution.

The results obtained and experience gained have been found helpful in planning the more elaborate series of experiments being conducted at the University of Illinois by the Joint Committee on Stresses in Railroad Track of the American Society of Civil Engineers and the American Railway Engineering Association.

DESCRIPTION OF APPARATUS

Fig. 1 is a sectional view of the apparatus used in most of the tests. A concrete slab, 9 x 8½ ft. x 16 in., was used to support the sand. A 6 x 6-in. opening extends horizontally into the slab about 3 ft. 8 in. from one side. A short vertical opening having an internal diameter of 4½ in. connects with the opening about 3 ft. from the edge of the slab. A 4-in. wooden plug, or plunger, with its upper surface flush with the top of the slab fits loosely in the vertical opening and rests on a knife edge on a 3-in. I-beam in the horizontal opening, which acts as a lever to transmit the load to a platform scale; the ratio of the load weighed on the scales to the load on the plug is 1:8.09.

In some of the experiments the vertical pressure transmitted through the sand was measured by means of the water pressure under a 6-in. diaphragm placed flush with the surface of the slab. A flange with a beveled edge was screwed to the top of a 6-in. pipe, and a diaphragm of packing rubber was clamped over the beveled edge by means of a beveled collar. The 6-in. pipe was connected to a pressure gage by means of a short ¾-in. pipe line. The loading device of the apparatus was movable, and in order to get pressures away from the



ARRANGEMENT FOR MAKING SAND-MOVEMENT PHOTOGRAPHS

reacted against a 20-in. I-beam connected with the slab by means of four 1-in. steel rods. The load was weighed with a calibrated steel spring whose deflection was indicated on an Ames dial gage.

Experiments were made with depths of sand of 6, 12 and 18 in., using building sand which was rather fine and very dry. Pressures were determined with the center of the load on the vertical axis of the plug (or diaphragm), and at horizontal distances of 3, 6, 12 and 18 in. from it. The sand was thoroughly compacted before readings were taken. For example, when experiments were being made on a depth of sand of 12 in. the plate was started on a layer of sand about 15 in. deep and forced down to the 12-in. depth. The load was then released and applied several times, and read-

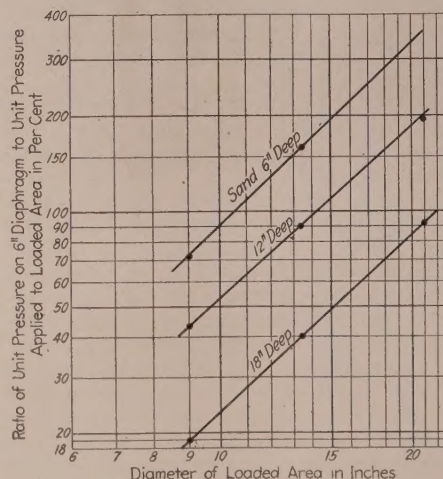


FIG. 2—RELATION BETWEEN DIAMETER OF LOADED AREA AND RATIO OF LOAD TRANSMITTED

ings were taken of the applied load and of the load transmitted to the plug.

EFFECT OF SIZE OF LOADED AREA

In order to determine the effect of the size of the loaded area upon the way the pressure is transmitted through the sand, the load was applied to plates 9, 13½ and 21 in. in diameter and measured with the 6-in. diaphragm. In these experiments the center of the diaphragm was directly below the center of the plate to which the load was applied. The average results of these tests are shown in Fig. 2. It will be noted that the size of the loaded area has an important effect on the proportion of the applied average unit pressure transmitted through sand of a given depth to the diaphragm. In these tests the 21-in. plate carried loads up to 18,000 lb., the 13½-in. plate loads up to 9000 lb. and the 9-in. plate loads up to 2500 lb.

In Fig. 2 the average values of the ratio of the unit pressure on the 6-in. diaphragm to the average unit pressure applied to the loaded area are plotted as ordinates and the diameter of the loaded area as abscissas, using logarithmic scales. It will be seen that parallel straight lines pass through the points plotted for each given depth of

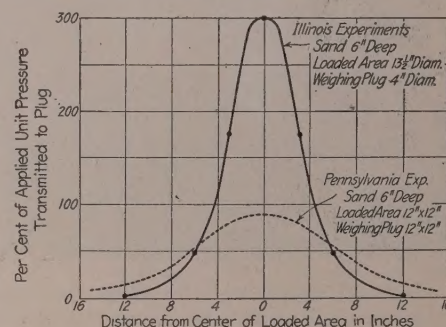


FIG. 3—VARIATION IN RATIO OF PRESSURES WITH DISTANCE—SAND 6-IN. DEEP

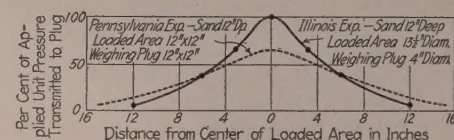


FIG. 4—VARIATION IN RATIO OF PRESSURES WITH DISTANCE—SAND 12-IN. DEEP

sand. From the slope of the lines it is found that the proportion of the applied average unit load which is transmitted through sand of a given depth to a diaphragm directly below varies as the 1.86 power of the diameter of the loaded area.

It follows, for example, that if a load is applied to a 9-in. plate such that the intensity of pressure on a small area at a certain distance directly below the center of the plate is 10 lb. per square inch, then if the same total load is applied to a 21-in. plate the intensity of pressure on the same small area would be 8.9 lb. per square inch. That is, with the area carrying the load increased 5.44 times, the intensity of the pressure in the sand directly below the plate at a given depth has been decreased but little, a conclusion very different from the usual assumptions.

PRESSURE VARIATION IN PER CENT

No experiments were made by the plug method to determine the effect of the diameter of the loaded area on the intensity of the vertical pressure at any given depth. According to the plug experiments made

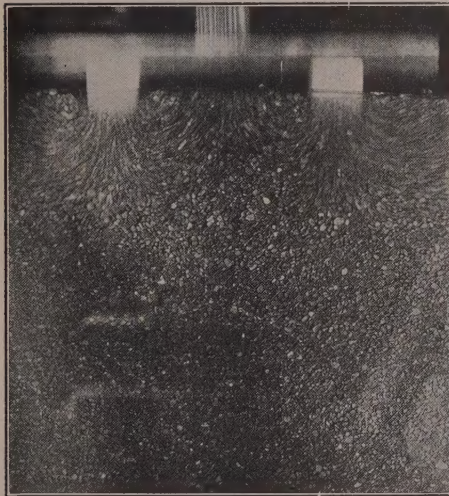
with the 13½-in. plate the ratio which the intensity of pressure directly below the center of the loaded area bears to the applied average unit load varies inversely as the 1.95 power of the depth of the sand above the plug. Assuming that this relation holds for other diameters of loaded area, and combining this result with the effect of the variation in diameter previously described, the following equation was found:

$$p = 91d^{1.86}/h^{1.95}$$

in which p is the ratio, expressed as per cent, which the intensity of the transmitted pressure at a point h inches directly below the center of the loaded area bears to the average applied unit load, and d is the diameter of the plate in inches. The equation represents roughly the results of the experiments, but it is not probable that it has general application.

DIAPHRAGM LESS SATISFACTORY THAN PLUG

In the experimental work the diaphragm has been found to be a less satisfactory method for measuring the transmitted pressures than the method of weighing the



MOVEMENT UNDER TWO 2-IN. BLOCKS ON 8-IN. CENTERS

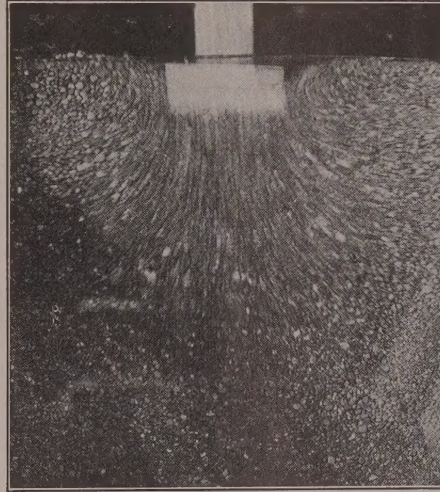
load on the plug. The reason is that the diaphragm becomes distorted when the load is applied, the center being depressed and the outside part raised by the water pressure, and the distortion increases with a repetition of the load. For off-center loadings the depression occurs in the part of the diaphragm nearest to the center line of the applied load, while the part farthest away is forced up. So much trouble was experienced with the bursting of the diaphragm that it could not be used for off-center loads on thin layers of sand.

TRANSMITTED LOAD MEASURED BY PLUG

In Fig. 3 and Fig. 4 have been plotted curves showing the intensity of the transmitted pressure at different distances from the center line of the applied load in terms of the applied average unit load, as determined by experiments in which the transmitted pressure was measured by the 4-in. plug, Fig. 3 being for a depth of sand of 6 in. and Fig. 4 for 12 in. The curves are of interest in showing the lateral distribution of pressure over a horizontal plane at a given depth. Dotted lines giving the results of experiments made at Pennsylvania State College, and reported by J. A. Moyer in the Engineering Record of May 30, 1914, page 608, and March 13, 1915,

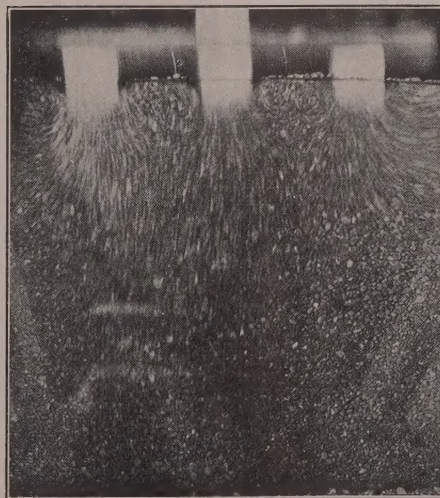
page 330, are also plotted in the two figures. In the Pennsylvania experiments the load was applied to an area 12 x 12 in. and the pressure was measured on a plug of the same size. The measured pressure was therefore the average over a relatively large part of the base.

The Illinois and Pennsylvania experiments have one inconsistency in common—the sum of the upward pressures under a 6-in. layer of sand exceeds the sum of the applied load and the weight of the sand. The reason in the case of the Illinois experiments is that center loadings were



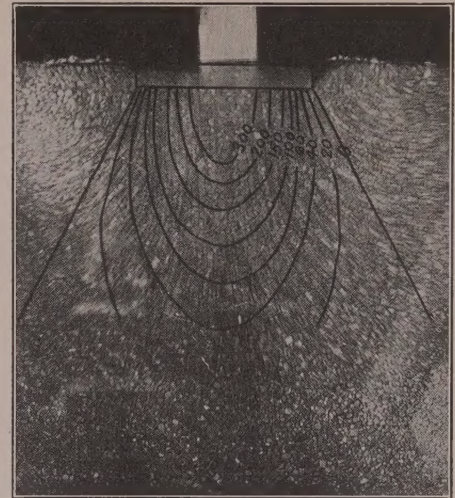
MOVEMENT UNDER SINGLE 4-IN. BLOCK

taken first, leaving a pillar of compacted sand above the plug which carried more than average pressures to the plug for the off-center loadings which followed. For depths greater than 6 in. the effect of the compacting was not as great. It is probable therefore that the readings at 3 and 6 in. away from the center are too high for the 6-in. depth of sand.



MOVEMENT UNDER THREE 2-IN. BLOCKS ON 5-IN. CENTERS

In Fig. 5 the results of the experiments are plotted to show lines of equal vertical pressure in the sand below the plate. The line of zero vertical pressure has been drawn downward on a 1:2 slope, and an inspection of the experimental results indicates that the vertical pressure outside of this line must be very small. It will be noticed that the region below the center of the load is one of high pressure, a fact of importance which seems generally to have



MOVEMENT UNDER SINGLE 8-IN. BLOCK—LINES OF EQUAL PRESSURE TRANSFERRED FROM FIG. 5

been overlooked. The diagram is instructive in showing the manner of the distribution of the vertical pressure at different depths and different distances from the axis of the load. It is seen that the pressure on any horizontal plane is far from uniform.

PHOTOGRAPHS SHOW SAND MOVEMENT

A number of photographs to show the direction of the movement of the sand under the action of a load were taken, some of which are reproduced herewith. The arrangement used for this purpose is seen in one of them. Sand which had the finer material screened out was piled against a sheet of plate glass, and the camera was placed about 3 ft. from the glass on the block shown. Time exposures of from 60 to 90 sec. duration were taken while the blocks were forced slowly and uniformly into the sand. As the sand moved, elongated images of the grains were formed on the photographic plate. The lines formed in this manner therefore show the direction of the movement of the sand for various conditions of loading. In one case the lines of equal vertical pressure from Fig. 5 have been plotted on the photograph.

Some of the views are suggestive in showing the manner in which the pressure in the ballast under a railroad tie is affected by the loading and spacing of the adjacent ties which restrain the horizontal movement of the ballast. It is evident also from Fig. 5 that the pressure in the ballast will not approach uniformity until a considerable depth is attained. Both the tests and the photographs suggest that the transmission and distribution of pressure downward through earth and ballast are different from the assumptions frequently held in explanation of such behavior.

This work was carried on at the Uni-

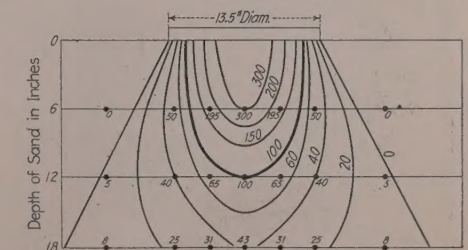


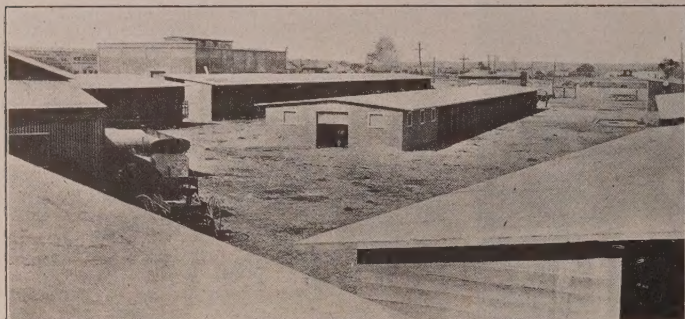
FIG. 5—LINES OF EQUAL VERTICAL UNIT PRESSURE IN PER CENT BASED ON 4-IN. PLUG TESTS

versity of Illinois by K. A. Burnell, 1910, W. C. Eells and J. Van Dervoort, 1911, L. N. Fisher and H. F. Wagner, 1912, and A. W. Kimbell and M. C. Taylor, 1913, as undergraduate thesis work.

Concrete Corrals Withstand Mule Heels

Municipal Warehouse and Yard Walls in a Southern Border City Are Built Like a Fort from Heavy Masonry

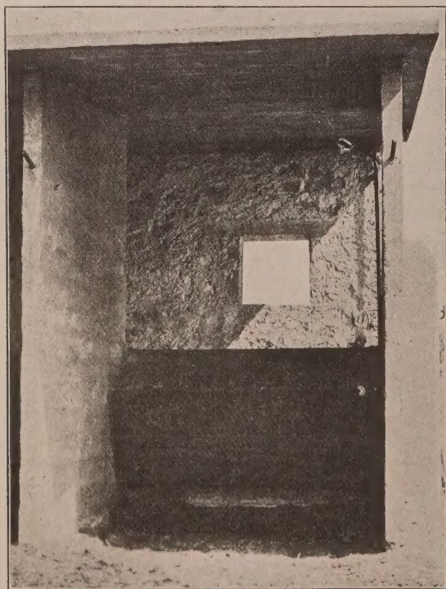
THE REINFORCED-CONCRETE stables at the El Paso (Tex.) municipal warehouse and corral were built during the early period of the troubles in Mexico, but they were not built primarily for protection from anything more strenuous than a vigorous mule's heels. At first 130 stalls



of the type shown in the photograph were constructed. The side walls are 3 or 4 in. thick and rest on 6 x 10-in. bases. The 4-in. roof is also of reinforced concrete, but the mangers are of wood with special feed boxes hinged so that they may be easily turned out. Industrial tracks for feed cars are laid down the center of the double-stall structure and in front of the single stalls.

In the same yard is a municipal storehouse for feed and waterworks accessories. Two earth platforms with stone retaining walls for pipe, valves and hydrants are 30 in. high to facilitate loading from railroad cars and to wagons.

The municipal plant was designed by and built under the direction of Herbert Nunn, city engineer. J. N. Gladding is now city engineer.



THE ROOF, SIDE WALLS, AND FLOOR ARE OF CONCRETE; THE MANGERS ONLY ARE OF WOOD

Tar Coating Protects High-Velocity Conduits

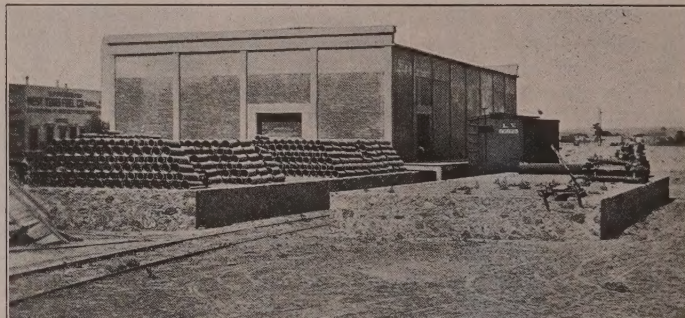
Arrowrock Dam Outlets of Concrete, Discharging at 60 Ft. per Second, Are Painted with Water-Gas Tar and Coal Tar

REFINED water-gas tar and coal tar, the same combination that has been used on metal subjected to water action by the U. S. Reclamation Service for several years, has been applied to the concrete outlets of the Arrowrock dam with success, according to an article by Charles H. Paul

the tar coating was found to be in excellent condition. In a few small spots the outer coating had come off, but even there the concrete surface was well filled with the tar and was still well protected, apparently, against water action. It is the opinion of the men familiar with all the conditions that the use of this tar coating gave thoroughly satisfactory results.

GET THIN TAR

In obtaining material for work of this kind it is very important that the water-gas tar be of very thin consistency. The



MASONRY WALLS IN CLOSE EARTH STORAGE PLATFORMS

IN THE CENTER IS A DOUBLE-STALL STRUCTURE

in the January *Reclamation Record*, from which the following notes are taken. The idea was not so much to waterproof the concrete as to fill all the minute voids in the surface so as to prevent the erosion caused by the formation of a vacuum in the small voids or pockets due to velocities of 60 ft. per second or higher obtaining under full-reservoir conditions.

The regulating outlets are molded in 1:2 Portland cement mortar, except for a 28-ft. section adjacent to the upstream face of the dam, which part is lined with semisteel pipe. The outlets are 4 ft. 4 in. in diameter, the upper ones being 70 ft. in length and the lower ones 130 ft. Wood pipe staves were used for lagging the forms, and great care was taken to secure a smooth and straight surface. After the removal of the forms they were trimmed, scraped and washed with grout in the usual way, after which they were painted with two coats of water-gas tar and two coats of coal tar. Preliminary experiments had indicated that the water-gas tar would penetrate the concrete, and that the coal tar would follow it in and bind to the concrete much better than if it were applied direct, thereby completely filling the voids at and near the surface and coating the concrete with a sleek and fairly durable finish, cheap and easily applied.

CONDITION AFTER SEASON'S USE

This coating was applied to all outlets during the fall of 1914. Five of the lower outlets and six of the upper outlets were in service during the irrigation season of 1915, some of them working for four and one-half months under heads varying up to a maximum of 100 ft., with corresponding velocities up to 64 ft. per second. All of the outlets passed through a fairly normal winter and summer. The one that was used most was operated nearly all the time with its valve only partly open. After this service careful inspection was made, and

manufacturers can supply it that way if it is made plain to them that this thin consistency is important, otherwise it is likely to come too thick. The manufacturers can also supply an oil for thinning this water-gas tar, and it is advisable to have some of this oil on hand in case it is needed, but it is believed that the success of the whole operation depends upon the very thin, water-like consistency of the water-gas tar. Both the water-gas tar and the coal tar should be refined.

It is necessary to have the concrete thoroughly dry at the time the first coat is applied. The water-gas tar may be applied without heating, and the second coat may follow the first immediately. The first coat of coal tar may be applied as soon as the water-gas tar has soaked in a little, but the second coat of coal tar should not be applied until after the first coat has set. Both coats of coal tar should be applied hot and brushed out as thin as possible, as a thick coating is much more likely to peel and run.

COST SMALL

The approximate cost of painting 1000 sq. ft. of surface in an outlet 52 in. in diameter with two coats of water gas and two of coal tar as described, was as follows:

Labor:	
4½ days at \$2.50.....	\$11.25
Material:	
12 gal. water-gas tar at 16 cents.....	1.92
15 gal. coal tar at 16 cents.....	2.40
Brushes and miscellaneous.....	1.43
	\$17.00

The refined water-gas tar and refined coal tar were purchased from the Barrett Manufacturing Company at \$4 per barrel of 50 gal., f.o.b. Chicago. Freight to Boise was about \$4 per barrel.

HALF OF THE PRISONERS in the State of Arizona are employed in highway and bridge construction camps, according to a statement by Governor George W. P. Hunt to the National Committee on Prisons and Prison Labor. The practice of employing convicts on road work in Arizona has been in effect more than three years.

Tunnel Drill Carriages—Their Economic Possibilities

Third and Final Article of the Series Describing Economies Effected in Mount Royal Tunnel by Bench and Trimming Drill Carriages, Pioneers in Their Field

By S. P. BROWN

Chief Engineer, Mount Royal Tunnel & Terminal Company, Limited, Montreal

[In the two preceding articles of this series Mr. Brown discussed the evolution of the drill carriage and the adaptation of European and American ideas to an advanced type of heading carriage used in the Mount Royal tunnel. In this last article he tells of the work done by unique types of drill carriage for bench work and trimming. —EDITOR.]

AFTER the heading and break-up work in the Mount Royal tunnel had been completed, as described in Part 1 of this article, in the issue of Jan. 8, page 38, two benches remained to be excavated, one on either side of the original heading gangway. These benches aggregated from 8 to 10 cu. yd. of solid excavation per foot of tunnel. The problem of drilling on the benches was a particularly difficult one, owing to their general tendency to slope toward the gangway and the extreme irregularity of their tops. To move and set up tripods under such conditions was not impossible, but very awkward and expensive, and the varying height and shape of the benches practically precluded columns. Another complication was added by the continuous traffic in the gangway, since the

design, as shown in Fig. 18. This condition made the roof treacherous and sometimes subject to initial strains. It was decided, therefore, to line the tunnel, practically throughout its length. Where the rock was very hard and dependable in character it was concluded that masonry side walls could be practically dispensed with. (See Fig. 19.) As most of the arch was designed to restrain original movement more than to support a severe or varying load, a somewhat flat single arch was selected, the excavation for which would permit the use of a twin section economically where conditions required it.

While the concrete is often brought right down to subgrade, the thickness of the side-wall concrete is at times very small, since the arch takes its bearing from a hitch cut in the tunnel haunch at about the level of the top of the bench. In order to economize in concrete to the greatest possible extent, somewhat flexible side-wall forms were used in concreting the section. They were attached to the arch forms like a curtain. The bottom was jammed hard out against the rock at the base of the rib and sprung out of line, so far as their flexibility permitted, to follow the irregularities of the rock face and at the same time to give the necessary haunch and support to the arch. This, of course, gave an extremely irregular and unsightly face to the side walls, but as such features cannot be seen in a tunnel under operation, the economical features were allowed to prevail in the design.

COST OF LINING LOW

This design of section and the peculiar design of forms resulted in a variety of economies. The quantity of concrete was greatly reduced. The labor required in moving and setting forms was reduced more than 60 per cent. The waste of lumber and bracing was greatly reduced. The excavation was also considerably reduced; by carrying the break-up width, at the haunch of the arch, wider than the tunnel width below the top of the bench the drilling was much facilitated. It was, in fact, this last point which made this method of bench excavation an assured success and determined the use of the bench drill carriage. Without the additional space provided above the bench by the widening of

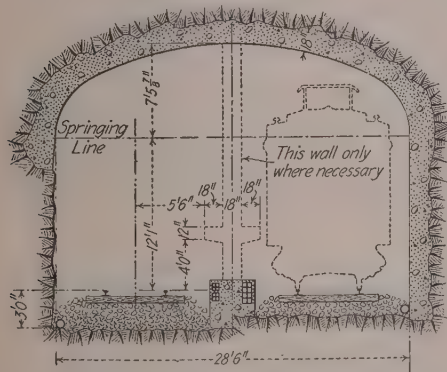
the excavation section at the haunch required for the "hitch" of the concrete arch, it would have been almost impossible to drill the channel holes along the rib to which the bench was broken in excavation.

BENCH DRILL CARRIAGE UNIQUE

The bench drill carriage is, the writer believes, quite original in the Mount Royal tunnel, both in type and detail. As finally



18.—IGNEOUS DIKES CUT ROCK INTO PATCHWORK OF INTRICATE DESIGN

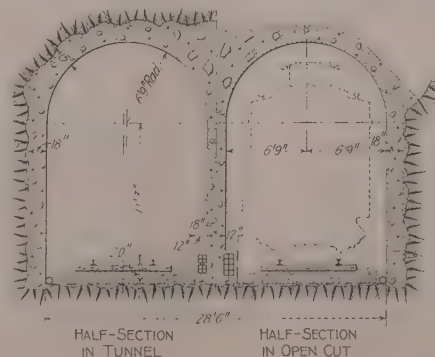


16.—TYPICAL CROSS-SECTION OF TUNNEL WAS DESIGNED FOR DOUBLE-TRACK ARCH

bench drilling had to be started long before the completion of the break-up excavation in the central part of the mountain.

TUNNEL LINING METHODS

The typical cross-section of the tunnel, in excavation, was designed normally for a single double-track arch, as shown in Fig. 16. Where the roof was unusually bad or liable to develop heavy pressures a twin-tube section (Fig. 17) could be substituted without an excessive waste of concrete. In general, the rock in the tunnel was good. Except where gypsum or a deceased form of Essexite was encountered, there was no tendency in the rock to disintegrate, and few mud seams or voids were encountered except near the portals. The main danger in the tunnel from rock movement or falls was due to the broken and distorted conditions of the original main bodies, resulting from ancient volcanic activities and the multitude of igneous dikes and sheets that cut the rock into a patchwork of most intricate



17.—WHERE ROOF WAS BAD A TWIN-TUBE SECTION WAS BUILT

designed, it is shown in Fig. 20. Eight to twelve drills were used on each carriage, equally divided between the two benches. As was the case on the heading carriages, these drills were never dismantled from their bar nor disconnected from the manifold except for repairs. As a small air-operated pump was carried on the carriage, water under pressure was always available for the drills without extra work for piping and connections. It will thus be seen that many of the economies inherent in ordinary drill carriage work, as detailed in Part 1 of this article, are also common to this type of carriage.

The carriage proper consisted of a heavy traveler, 30 ft. long, which was moved along the heading gangway as the drilling progressed. The wheels were double-flanged and had very heavy axles, sufficiently long to give lateral play that would enable the wheels to follow the local irregularities of the track horizontally. The vertical play required was given by the spring of the traveler frame itself. The gage of the carriage track was of such a width that the side trusses comfortably cleared the gangway sides in all places and at the same time permitted a single muck track to operate between them. The traveler was fitted at each side with an adjustable outrigger supporting a horizontal quarry bar, which in turn carried the drills.

A heavy platform was built between the

side trusses of the carriage, sufficiently high to clear the traffic in the gangway below and yet to act as a very substantial brace for the carriage structure. The total height of the carriage was such as to clear the tunnel roof comfortably at all places. The longitudinal bracing was sufficiently strong to hold the carriage square and make it reasonably rigid. The lateral braces, especially the cross struts between the main side trusses, were extremely heavy to take up the thrust from the jack arms supporting the drill bars. The vertical posts of the carriage were also very heavy, being reinforced with steel angles, as they had to span between the repair platforms and the top braces, and carry the thrust from the jack arms. Thus the carriage was very rigid, so far as the drilling equipment was concerned. On the platform above the gangway tracks, used for repairing drills, was a workbench, testing blocks, etc.

OUTRIGGERS SUPPORT DRILLS

The angles reinforcing the vertical posts were punched at regular intervals to give a

ties in the bench expedited the work to the greatest degree.

The extra width in the tunnel allowed at the haunch for the arch support very much facilitated the drilling. Two parallel lines of bench holes were usually drilled. The outside line next the rib acted as channel or line holes, varying in spacing from about 4 ft. to 8 in., depending on the character of the rock and the accuracy of the line required in the tunnel wall. The second line of breaker holes was spaced farther apart. The line holes were only loaded when the rock was such that it would not break to line from the breaking holes. Thus the sides of the tunnel were not shattered by heavy blasting, and the overbreak was unusually small. This was also true of the break-up excavation, since all the blasting there, being to two faces, required only the lightest kind of shooting. While the headings used 5 to 7 lb. of 60 per cent powder per cubic yard, the break-up and bench excavation averaged less than 1 lb. to the yard.

As the drill carriages kept well ahead

side of the bar when drilling the line holes and on the inside when drilling the breaking holes.

PROGRESS 90 FEET A DAY

The progress obtained with this drill carriage amounted to from 30 to 90 ft. of tunnel per day, depending principally upon the character of the rock and the configuration and condition of the bench. When the ground was particularly irregular and was cut by dikes or when the bench was found to be somewhat shattered from previous blasts the drilling would be slow and uncertain, often several holes being necessary to secure one of the proper depth and direction. Again, when the top of the bench was very irregular or sloped at a steep angle, it was often tedious work to start the holes. Compared with the time required for drilling with columns or tripods, however, the progress was more than merely satisfactory.

It has been found that even under favorable conditions on outside rock the lost time in tripod drilling often amounts to 50



19.—WHERE THE ROCK WAS HARD AND DEPENDABLE, MASONRY SIDE WALLS WERE OMITTED IN MOUNT ROYAL TUNNEL

hinge connection to the outrigger arms that could be shifted vertically as the height of the bench required. These arms were attached to the post angles by a pin connection, as seen in Fig. 20, thus giving them a vertical swing, which was used especially in moving from one location to another. Each outrigger, one on either side of the carriage, consisted of four jack-arms and a 30-ft. quarry bar. The arms were hinged to the carriage, as just described, and had janks at the outer ends which screwed against the tunnel haunch, fixing the carriage, as a whole, firmly in position. The arms were made up of 4-in. extra heavy pipe with the same end jacks that were used with the drill bars in the heading and break-ups. In fact, these bars were actually used in this drill carriage, so far as the number available would permit.

The drills were mounted on column arms, or the special saddle arms described for heading work in Part 2. These were clamped to the horizontal quarry bar, as in the case of the heading drill bar, so that the drills had every flexibility in setting up and operating. The rigidity of the carriage and supporting apparatus reduced vibration to a minimum, while the ease of moving ahead and fitting local irregulari-

ties of the blasting, and as all the bench muck was handled by steam shovel, only two muckers were required in each drill-carriage crew. These two men cleaned off the top of the bench and extended the drill carriage track, with the aid of the helpers, as the carriage moved ahead. One electrician attended to all the trolley and lighting work connected with both drill carriages, and one mechanic did all the pipe-fitting and drill repairs necessary for both drill carriage outfits. The platform on each carriage above the muck track was mainly used for repairing drills and the storage of extra drills, spare parts, steel and supplies for daily use.

HOW CARRIAGE WAS MOVED

When moving the jacks were released and the outriggers, including the quarry bars with the drills on them, were raised by blocks and tackle attached to the top of the carriage posts. The tackle was worked by 10-in. pipe-winding rollers, 30 ft. long, at the top of the carriage frame, one on each side of the carriage. These rollers were turned by hand by means of drill steels through holes drilled at right angles near the ends of the rollers. The quarry bar was so set on the jack arms of the outriggers that the drillers worked on the out-

per cent of the time actually spent with the machines. This is due not only to the delay in setting up, but to the time lost in shifting the tripod to "follow the hole." It can be readily seen that practically all of this lost time is eliminated in the case of the drill carriage, where the drill supports are rigid and the drills may be shifted accurately and expeditiously with a minimum of labor.

After the drill carriage had got a good start a powder crew was sent in from the west portal and the benches blasted well ahead of the steam shovel. By this method the shovel, a model 41 Marion, never had to back up for shooting, full time being spent in excavation. Five to six hundred cars of muck were usually handled per day of two 10-hr. shifts. This aggregated 1200 to 1500 cu. yd. of loose material, or about 700 to 1000 cu. yd. solid. The linear progress of the shovel sometimes exceeded 600 ft. per week where there was nothing but bench excavation removed. Fig. 21 shows the shovel working in the standard bench section.

The yardage price received for the crushed stone at the west portal crushing plant, all of which was sold except that required for the company's tunnel and railroad purposes, was more than sufficient to

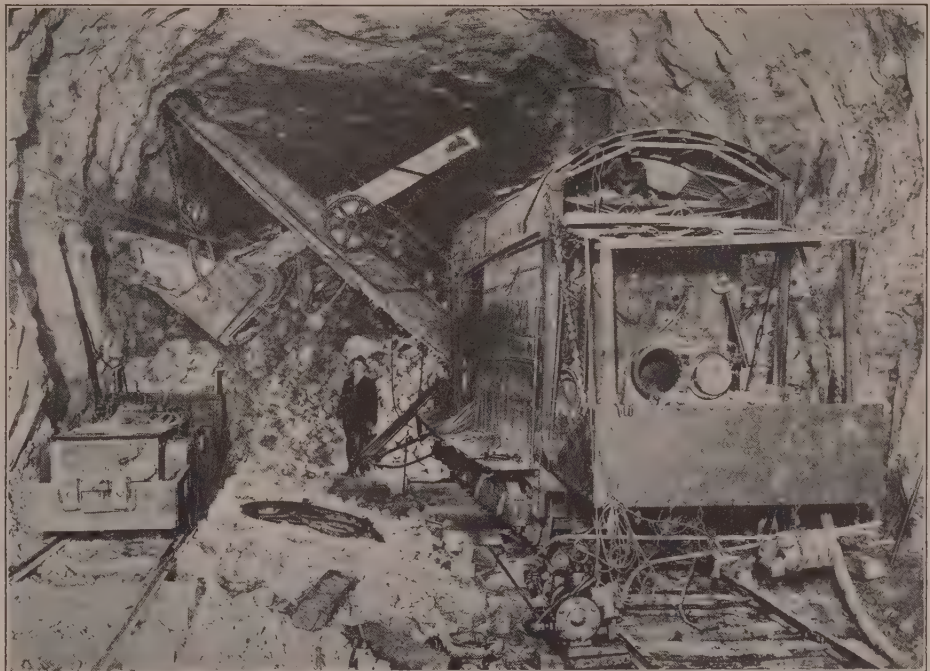
cover the yardage cost of drilling, blasting, powder, mucking, transporting, crushing, marketing, power, supplies and overhead charges in the case of the bench excavation. This unusual economy, of course, was not entirely due to the bench drill carriage. As the bench was already somewhat shaken and very much exposed, it required comparatively little drilling and powder to break it. The mucking conditions were as nearly ideal for a tunnel as one could ever hope for. Then, too, the price of stone was high—70 to 75 cents per net ton. On the other hand, had it not been for the drill carriage there is no doubt but that the cost of drilling would have been very excessive and the progress heart-breakingly slow.

The writer considers the bench drill carriage not only the most unique feature in the Mount Royal tunnel excavation equipment, but by all odds the greatest money saver in comparison with the amount involved.

THE TRIMMING CARRIAGE

The final trimming of the tunnel section, preparatory to lining, is too often a very measurable percentage of the total cost of any tunnel excavation. There are many cases where the cost of trimming, added to the cost of extra concrete and packing required to fill in cavities left by falls and careless or inaccurate excavation, has exceeded the actual first cost of excavation. For some reason this is an item very often overlooked by a contractor, especially if he is not thoroughly experienced in making up his bids for tunnel work.

This was one of the very important factors in determining the system finally adopted for excavating the Mount Royal tunnel. While the blasting in the heading was necessarily quite heavy, this heading was in the center of the tunnel and along its subgrade. All blasting immediately adjoining the actual perimeter of the finished tunnel excavation was very light, and all outside holes were drilled practically parallel to the face of the tunnel walls and roof.



21.—STEAM SHOVEL, WORKING IN STANDARD BENCH BEHIND DRILL CARRIAGE, LOADED 600 MUCK CARS WITH 1500 CUBIC YARDS OF LOOSE MATERIAL PER DAY OF TWO TEN-HOUR SHIFTS

This not only resulted in remarkably cheap excavation, but enabled the tunnel to be driven very close to the theoretical neat line of excavation, and, as the blasting was light, the surrounding ground was hardly shattered at all. The scaling, therefore, was simple and expeditious, and in spite of the broken and uneven character of the ground, serious falls were very rare. The actual overbreak averaged less than 5 per cent, and the amount of trimming was comparatively small and very conveniently located for its economical removal, only heavy trimming being in the lower corners of the tunnel cross-section.

This trimming, if such it may be called, was left because in places the bench was so high that the line holes could not be drilled

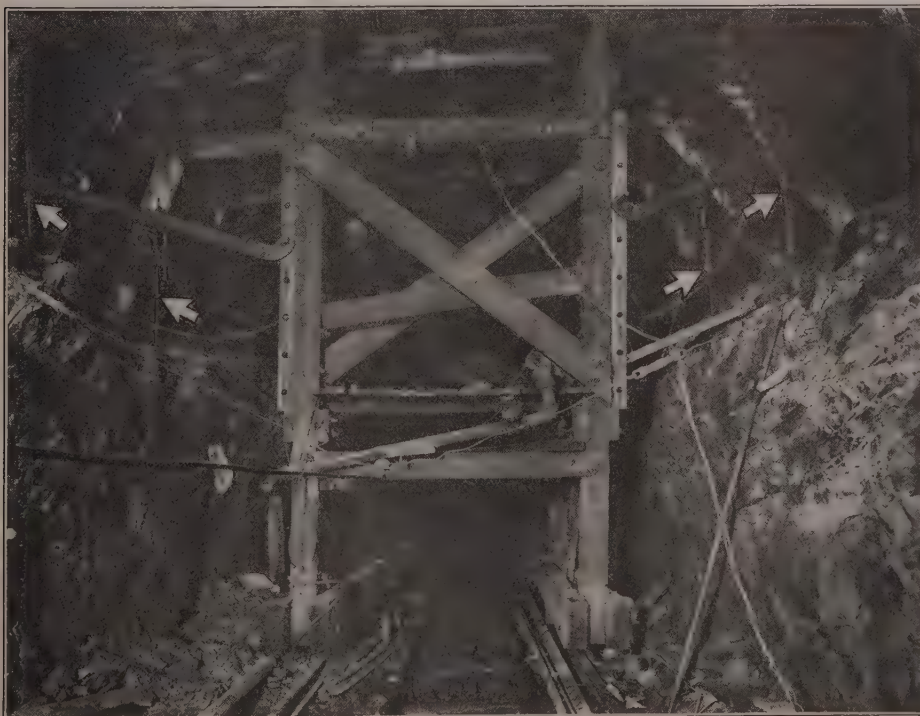
to subgrade—at least without bending the steel, which was not practical under the circumstances. With the line holes not down to subgrade, the breaking holes could not break the rock back to the neat line, thus leaving a very appreciable toe of rock along the sides in many places.

The trimming on the sides of the tunnel was insignificant, except where the hitch was required for the arch. Here, while there was a general difference in line of about 18 in. between the haunch and the sides of the tunnel below, the shoulder had to be squared up to give a firm and reliable bearing for the masonry. This hitch commonly occurs about 10 ft. above subgrade, but there was no effort made to have this line uniform. The hitch was cut wherever it happened to come, its elevation sometimes ranging from nearly subgrade to the actual springing line of the arch, in the same form section. In Fig. 22 the men may be seen drilling for the hitch on each side of the drill carriage at about its normal elevation.

HAND DRILLS FOR TRIMMING

The roof trimming was unimportant, except where the general elevation had to be raised owing to the development of the ground when fully exposed, making a heavier arch advisable than was at first thought necessary. Nowhere, however, was this trimming heavier than to require pneumatic hand drills for its removal.

The trimming drill carriage (Fig. 22) is very similar in construction to the bench carriage except that it is only 20 ft. long instead of 30 ft. In fact, much of the material used in its construction came from one of the bench drill carriages. It consists of two side trusses, 20 ft. long, traveling on six double-flanged wheels. As in the former carriages these trusses are so spaced as to permit the passage of a train of tunnel cars, both for muck and concreting materials. Immediately above the track is a platform for storage and repairs. In this carriage, however, the outriggers with their quarry bars and heavy drilling equipment are at the bottom, where the only heavy drilling occurs. The outriggers



20.—EACH BENCH DRILL CARRIAGE, A HEAVY TRAVELER 30 FEET LONG, CARRIED FROM EIGHT TO TWELVE DRILLS, WHICH WERE NEVER DISMOUNTED FROM THEIR BARS OR DISCONNECTED FROM MANIFOLD; THE DRILLS WERE CARRIED BY OUTRIGGERS AS SHOWN BY ARROWS

are attached to the frame of the carriage and are operated very like those already described, except that, since they are shorter and lighter, no winding rolls are provided.

PLATFORMS ADJUSTABLE

On about the level of the repair deck are side platforms carrying the men who drill for the hitch of the arch. These platforms extend the whole length of the carriage, on either side, and have a lateral adjustment which enables them to be drawn in when moving the carriage and extended when desired to fit any irregularity of the tunnel wall. The top deck, where the driller stands who scales and trims the tunnel roof and haunches, also has wings, bracketed out on either side to enable him to reach any part of the roof. As these wings are, however, considerably narrower than the tunnel section at that height, no lateral adjustment is required.

All drills used on this carriage are self-

may be particularly appreciated from the fact that the cost of trimming, including squaring up the hitch and removing the debris ready for the concrete form carriages, adds less than 5 cents to the yardage cost of the tunnel excavation.

CONCLUSION

In concluding this series of articles there is little to add to what has already been said. The use of tunnel drill carriages must depend upon each tunnel which comes under consideration. In general, they are serviceable and economical, lending much to the accuracy of line, regularity and rapidity of progress, and saving much wear and tear on both men and equipment. If certain systems of excavation are adopted, or if the ground is particularly bad, they become impractical. Where the tunnel is very short or very much subdivided they might add unduly to the plant charge or have no opportunity for systematic and continuous operation. It is absurd to try to lay

directly in charge of the construction work.

Most important, however, for the success of this work, where so much originality has been required, has been the absolute confidence and co-operation of the company's principals, Sir William Mackenzie, president, and Sir Donald Mann, vice-president, of Mackenzie, Mann & Company, Ltd. This was particularly so of Sir Donald Mann, who is more directly responsible for all the construction work, not only that of Mackenzie, Mann & Company, Ltd., but also that of the Mount Royal Tunnel & Terminal Company, Ltd., and the Canadian Northern Railway, which they also control. This co-operation enabled advantages to be taken of conditions as they arose and made possible many economies that cannot usually be effected on ordinary contract work.

Proposes Numerical Rating of Woods for Ties

Would Develop Standard Table of All Species According to Mechanical Properties— Urges More Attention to Seasoning

DISCUSSING woods suitable for cross-ties R. Van Metre, at the convention of the American Wood Preservers' Association in Chicago this week, mentioned a rating system on which the U. S. Forest Products Laboratory has been working, and presented a table of relative values of timbers for tie purposes, based on tests made at the laboratory. He suggested the desirability of developing a standard table of this sort to include every species available, based on a large number of tests. He also urged that more consideration be given to the matter of seasoning, which, he said, would make so-called softwoods serviceable and conserve the supply of red oaks. These notes are taken from his paper.

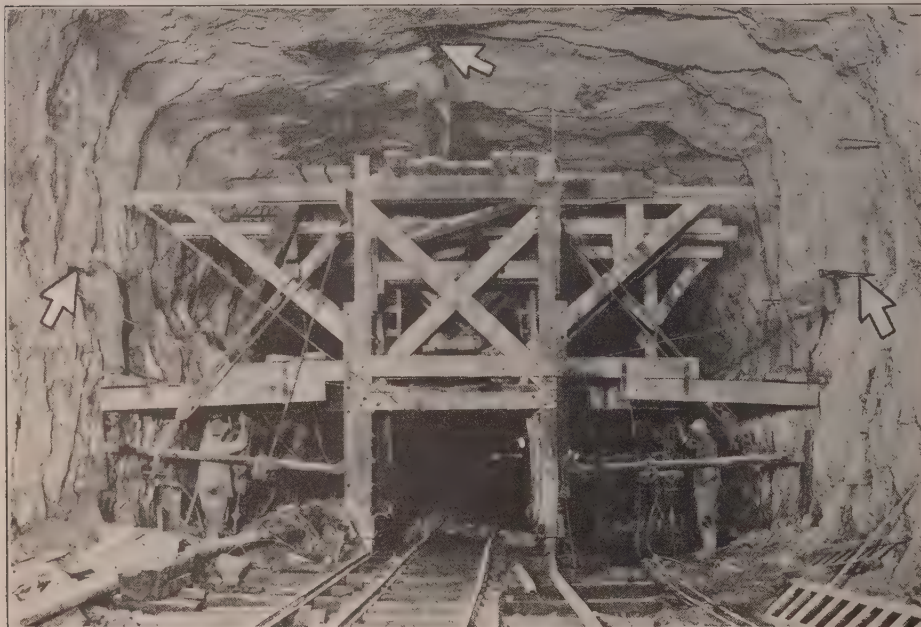
VALUE OF WOODS FOR TIES

In considering the value of any species for a tie, aside from the natural durability and its capacity for treatment, there are three points of importance: (1) That it be sufficiently strong to withstand the ordinary strains due to center binding, etc.; (2) that it be sufficiently dense to resist spike pulling and lateral pressure on spikes, and (3) that it be sufficiently hard to have a proper resistance to rail wear.

It is desirable that some classification of the mechanical suitability of the different species as ties be established from a comparison of their mechanical properties. The Forest Products Laboratory has been working on this, and has suggested the practicability of basing a classification upon a composite figure involving the following mechanical properties:

1. Static bending.
 - a. Modulus of rupture.
 - b. Fiber stress at elastic limit.
2. Impact bending.
 - a. Fiber stress at elastic limit.
3. Compression parallel to grain.
 - a. Maximum crushing strength.
 - b. Fiber stress at elastic limit.
4. Compression perpendicular to grain.
 - a. Fiber stress at elastic limit.
5. Hardness.
 - a. End hardness.
 - b. Side hardness.

Such a method, using the results secured in the many thousands of tests conducted at the laboratory on small clear specimens, and combining the data on a basis which would seem to give to the different prop-



22.—IN TRIMMING CARRIAGE OUTRIGGERS WITH THEIR HEAVY DRILLING EQUIPMENT ARE AT BOTTOM; MEN ON PLATFORMS AT SIDES ARE DRILLING HITCH FOR ARCH LINING SUPPORT

rotating pneumatic hand drills except those mounted on the quarry bars at the bottom, where the standard piston drills are used.

As in the case of the bench drill carriage, water is provided for drills at the carriage, and the heavy drilling equipment, once mounted, remains undisturbed on its bar from move to move. With this carriage the blasting is carried immediately behind the drill carriage as it progresses, but as it is very light it seldom obstructs the track for more than a few minutes, and causes no particular damage.

Aside from the usual advantages common to all drill carriages, the main value of this carriage is its lightness and ease of movement from place to place as it proceeds down the tunnel. Of course, it is self-evident that in this case the usual laborious scaffolding required in ordinary trimming operations is eliminated. The danger to workmen from hurriedly and often carelessly erected scaffolding is also eliminated, and it is a noteworthy fact that a man works faster and more effectively where he has a sense of security and is entirely familiar with his immediate surroundings.

It has been noted that the amount of trimming actually required is small. This

down hard and fast rules or to say that they are universally advisable. It is equally absurd for an engineer, if he is acquainted with their use, to fail to take advantage of their economic possibilities where the opportunities exist for their operation. This is especially so where the tunnel is long and the time of completion is important.

ACKNOWLEDGMENTS

The writer wishes to mention the keen interest, co-operation and undivided loyalty of his staff and entire organization in all of the work on the Mount Royal tunnel, without which neither the records for progress which have been made nor the economies which have been obtained would have been possible. This acknowledgment is particularly due to W. C. Lancaster, electrical-mechanical engineer; J. C. K. Stuart, principal assistant engineer; H. T. Fisher, lately tunnel engineer; Richard Byers, general superintendent, and Rufus Gent, electrical-mechanical superintendent. Mr. Fisher's advice on the heading drill carriages was invaluable. The idea for the bench carriages came from Mr. Gent, while much of the detailed design, especially of the latter carriages, was due to Mr. Stuart, who has been

erties a proper and reasonable weight in the composite figure, would result in the accompanying classification of some well known species. The figures given are for average forest-grown material, and individual pieces of any of the species may vary as much as 30 per cent above or below the average.

TIMBERS ARRANGED IN ORDER OF THEIR MECHANICAL VALUE AS TIES

No.	Species	Average composite value
1	Black locust.....	1666
2	Sugar maple.....	1140
3	White oak.....	1050
4	Red oak.....	972
5	Beech.....	955
6	Longleaf pine.....	914
7	Red gum.....	825
8	Shortleaf pine.....	800
9	Western larch.....	790
10	Tamarack.....	740
11	Eastern hemlock.....	700
12	White fir.....	610
13	Lodgepole pine.....	590
14	Western yellow pine.....	560
15	Northern white cedar.....	420

The idea of attempting to develop a standard table of this kind based on a large number of mechanical tests is worthy of careful consideration. It can be enlarged to include every species which is available in sufficient quantities, and would be of considerable value to anyone facing the situation caused by the decreasing supply of oaks.

CONTROL OF SEASONING IMPORTANT

In addition to the mechanical properties, an important factor in determining the suitability of any species as tie material, is the question of how a wood undergoes seasoning. A few years ago the specifications of many of the roads required that ties be winter-cut, but in most cases this requirement has been eliminated or entirely ignored. If that requirement had been rigidly insisted on, with regard to the so-called softwoods, such truly serviceable woods as beech, gum, the maples, birch and elm, would probably be standing favorably with the red-oak group, instead of having yet to prove their merit. Summer-cut ties of these species are subjected to severe checking and deterioration by incipient decay before treatment that winter-cut ties escape to a great extent.

The solution of the problem of handling these softwoods is simple in theory, though more difficult in practical operation. It requires two things: Rigid restriction of the cutting period to the months between Oct. 1 and March 1, and the proper piling of ties for seasoning at every stage from the woods to river bank or right-of-way to the treating plant yard. Unfavorable results from treated ties made of these woods can usually be traced to failure to observe these precautions.

It is generally conceded that red oak is the very best wood for ties. It is strong, easy to treat, easy to handle to avoid deterioration before treatment, hard to resist rail cutting and spike pulling. For these reasons all concerned would gladly limit their operations in treating ties to this wood, if there were sufficient timber available to supply the demand. But the red oaks for ties are fast going the way of the white oaks. The so-called inferior woods must make up the shortage, and of these, the timber supply and rate of growth will take care of the demand for many years.

It is not too early to begin to conserve the supply of red oaks for future use in track where the service is severe. This

can be accomplished by letting down the bars to other woods on their merits as proved in the test tracks maintained by most large roads that are most earnest in their efforts to determine each wood's value as tie material. It is only a matter of time when every wood having the requisite

mechanical properties will be used for ties. That time will come when the producers and consumers of ties will co-operate to control the period of cutting and method of seasoning, so that ties will reach the treating plant with their natural condition unimpaired by checking and incipient decay.

Stresses in 50-Ton Steel Derrick Reduced by Elimination of Goosenecks

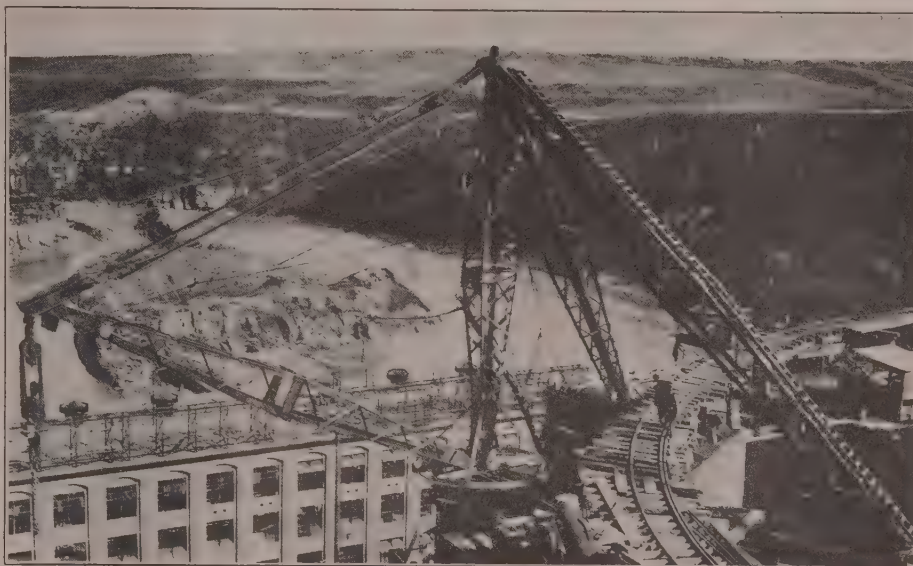
Easy Swinging Secured by Transferring Stress from Boom Line to Mast Below Stiffleg Connection—Rocker Arm Is Feature of Boom End

THE UNDESIRABLE bending moments which have to be considered in the design of the stifflegs and goosenecks of derricks as ordinarily constructed were entirely avoided in the case of a 50-ton steel stiffleg derrick of recent construction. This was accomplished by the development of a cast-steel head which takes the place of goosenecks and directs the stresses in the stifflegs

which secures the boom-line link to the gudgeon pin, to insure freedom of action. The boom-line link is cast steel, of I-section, curved to clear the head and allow for free swinging at low boom.

ROCKER ARM GIVES ADDED HEADROOM

A further unusual feature embodied in this derrick is the arrangement which



FIFTY-TON DERRICK DESIGNED TO ALLOW AXIAL STRESSES ONLY IN EVERY MEMBER

along lines coincident with their longitudinal axes.

One of the accompanying illustrations shows a sectional view of this head, together with the terminal of the mast and stiffleg, the gudgeon pin, and the link leading to the boom line. It will be noted that the axis of the stiffleg and that of the mast intersect exactly in the center of the opening in the top of the steel head through which passes the gudgeon pin. This gives a direct application of stresses not only in the stifflegs but in the head as well.

Another important feature, but one not so apparent, is the arrangement whereby the vertical stresses resulting from tension in the boom line at low boom are transmitted directly through the gudgeon pin to the mast without in any way reacting upon the steel head or influencing the moment required to swing the boom in a horizontal plane at full load. This is accomplished by articulating the boom-line link with the gudgeon pin by means of the semi-circular recess at the upper extremity of the latter, and the introduction of a heavy bridge, or key, of rectangular cross-section, which passes through the mast and the lower end of the gudgeon pin, securing the one to the other. A small space, about $\frac{1}{8}$ in., is provided between the steel head and the clevis

forms the junction of the outer end of the boom, the boom line and the fall line. It is a rocker arm built of two pieces of heavy 15-in. channel 5 ft. long, set back to back 15 in. apart and riveted to a cover plate of $\frac{3}{8}$ -in. sheet steel. This rocker arm is provided with three pins passing through it transversely, one at either end and one located about three-quarters of the way between these two. The last-mentioned pin hinges the rocker arm to the end of the boom, the longer end of the rocker arm pointing upward and toward the mast of the derrick and the short end projecting beyond the end of the boom. The shorter end supports the upper sheave block of the fall line, and the boom-line sheave block connects to the long end. When the derrick is loaded the rocker arm assumes a position which establishes equilibrium and directs the stress in the boom along the line of its longitudinal axis, whether at high or low boom. Obviously this feature accomplishes nothing more than would two bails, or bridles, but it is much cheaper for heavy duty, and is accompanied by much less loss of headroom than attends the use of bridles.

The derrick consists of a 48-ft. boom, 41-ft. mast and 58-ft. stifflegs. The mast, stifflegs and boom were built of 6 x 6-in. angles, $\frac{9}{16}$ in., $\frac{1}{2}$ in. and $\frac{7}{16}$ in. thick,



ROCKER ARM IS MUCH SHORTER THAN BRIDLE OF SAME STRENGTH

in the order named. The lacing is $2\frac{1}{2}$ -in. and 3-in. angles, double-riveted. The gudgeon pin is 9 in. in diameter. The derrick was located on existing concrete walls, which largely determined its general dimensions, and for this reason also it has no sills. The back end of each stiffleg was secured to the concrete by being pin-connected to two straps, each 1 in. thick and 8 in. wide, extending 16 ft. into the concrete in a direction exactly in alignment with the axis of the stiffleg. These straps or bars were reinforced at their upper extremities so as to provide for pinning without loss of effective cross-section.

The rigging consisted of nineteen parts of $\frac{3}{4}$ -in. boom line and sixteen parts of fall line of the same diameter. The boom line was led into the mast near the top and thence down to the hoist. The load line was

led down the inside of the boom to the foot of the mast to protect the derrick against the possibility of a careless operator lowering his boom against his load line and parting it. The load line, due to the considerable distance through which loads were handled, was more than 2000 ft. long. The derrick was provided with a bullwheel 14 ft. in diameter, and its operation was so free that it was swung with ease by a $\frac{5}{8}$ -in. cable, even when loaded. Power was supplied by an 8 x 10-in. three-drum, extra-heavy hoist.

LOW UNIT STRESSES ADOPTED

The unit stress taken was approximately 10,000 lb. per square inch throughout, except the riveting, which was taken at 8000 lb. per square inch. In determining the stress in pins, that resulting from bending moments was in all cases considered, and applied whenever it exceeded shear.

The derrick was built by the Great Falls Power Company to lower machinery to the power house of its new 90,000-hp. hydroelectric development at Great Falls, Mont. It was designed and its construction supervised by M. T. Thompson, assistant superintendent during construction of that development. The steel was sheared and punched in a small shop within 12 miles of the job, while the rest of the work was done in the company's field shop, even to the manufacture of the sheave blocks.

TO POPULARIZE GEOLOGY the U. S. Geological Survey has printed on the backs of several of its topographic maps non-technical descriptions of the physical features of the area mapped, and of their origin. That the general public appreciates these descriptions, states a bulletin issued by the Survey, is shown by the increased demands for the maps. Consequently, such matter is to be published for the map of the Crater Lake National Park, Oregon; the Bright Angel area in the Grand Canyon of Arizona; the Delaware Water Gap, and other areas. The work involves comparatively little expense.

Wood-Block Flooring Said to Have Proved Its Worth

C. H. Teesdale Tells American Wood Preservers' Association of Favorable Reports Received from Many Users of the Blocks

IT IS ONLY a few years that creosoted wood blocks have been used for the flooring of factories, warehouses and other buildings. Yet they have already proved their worth, judging from information presented at the wood preservers' convention in Chicago this week by C. H. Teesdale of the U. S. Forest Products Laboratory. Mr. Teesdale has summed up and tabulated the answers to questions submitted to a large number of users of wood-block flooring, as well as the manufacturers of the creosoted blocks. His summarizing of the data received is as follows:

FEW CASES WHERE TROUBLE HAS DEVELOPED

The results of this investigation indicate that treated wood block makes a desirable type of flooring for many purposes, and it is likely that its use for interior work will increase. Since its large use for these purposes is just beginning, one might expect that unforeseen trouble would develop. The records of 160 floors indicate, however, that serious trouble has developed in a very low percentage of cases.

Most of the trouble has come from shrinkage or expansion of the blocks. To prevent these troubles it is necessary to study each case where blocks are to be laid, and to treat the blocks accordingly. For dry situations the blocks should be well seasoned before treatment and laid in the floor while thoroughly dry. In wet or alternately wet and dry situations dry blocks would give expansion trouble, hence the timber should be green or only semi-air-dry when laid. Even dry interiors are liable to be accidentally subjected to water, however; hence it would seem desirable as a rule to use bituminous fillers instead of sand filler.

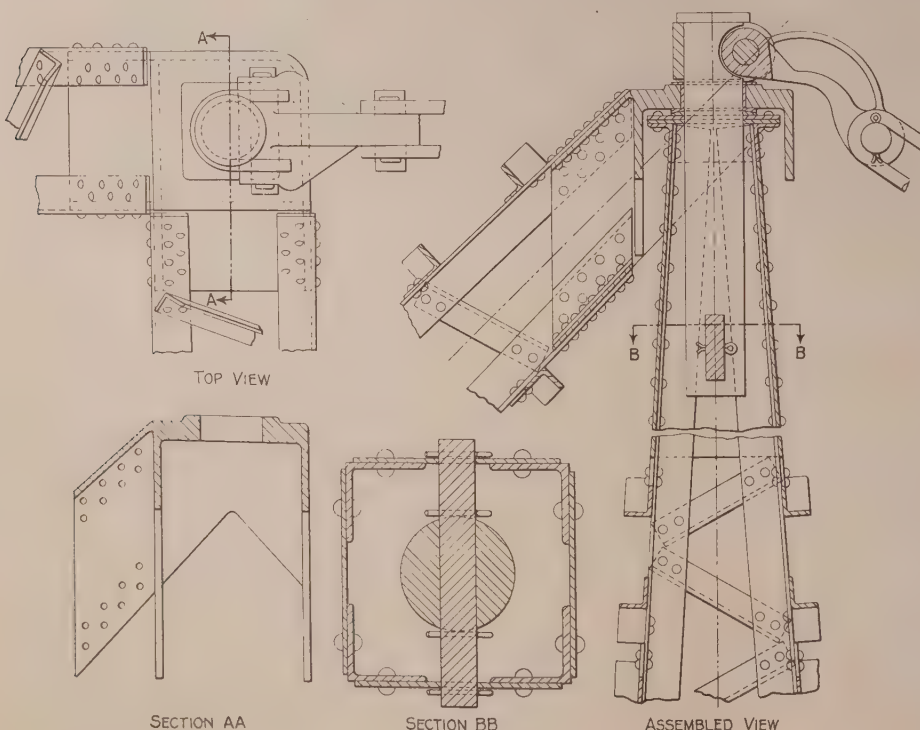
Sand cushions were probably a source of trouble in several cases. If there is any vibration, or if the sand is at all liable to shift, a bituminous or cement grout cushion is to be preferred. Sand cushions are also liable to cause uneven floors if the blocks shrink, and it seems likely that many cases of shrinking would not give serious trouble where bituminous filler and bituminous or cement grout cushions are used.

Bleeding caused very little trouble. In dry and very warm situations, where it is most likely to occur, it would be desirable to consider carefully the method of treating and handling the blocks in order to avoid objectionable bleeding.

WOOD BLOCKS NOT ALWAYS SUITABLE

In a few cases it seems likely that wood block should not be used. For example, it should not be used where butter or tobacco products are stored. In some foundries, where hot castings are thrown upon the floor, the blocks have burned through to the foundation. Wood blocks may be objectionable where the soiling or staining of certain classes of merchandise would lower the value, and in one case where used in a tennis court wood blocks were a failure and had to be removed.

Wood block has been found to be very satisfactory in many cases where heavy castings are thrown about or where heavy



DETAILS INSURE AXIAL STRESS IN MAST AND STIFFLEGS AND MAKE SWINGING EASY

trucks are moved, and it is liked by workmen because it is warm and easy on their feet.

The replies from the users of wood-block flooring indicate quite strongly that when new wood-block floors are to be laid a careful investigation of all the conditions existing or likely to develop should be made by the manufacturer. The method of treatment and construction of the floor should then be adapted to the special conditions found. If this is not done many cases of dissatisfaction are very liable to develop.

Santa Barbara Has Subterranean Storage Reservoir

Tunnel Running 2 Miles Into Hill Has, Near Portal, Watertight Bulkhead Through Which Passes 8-Inch Pipe with Valve

THE CITY of Santa Barbara, Cal., has, as part of its water-supply system, a natural underground reservoir, tapped by what is known as the Cold Springs Canyon

Five Schemes Considered for Power Development at Kananaskis Falls, Alberta

Part 2—Type of Canal Lining Carefully Studied—Power House Built Mainly Below Ground Surface to Lessen Vibratory Effects

By HAROLD S. JOHNSTON
Banff, Alberta, Canada

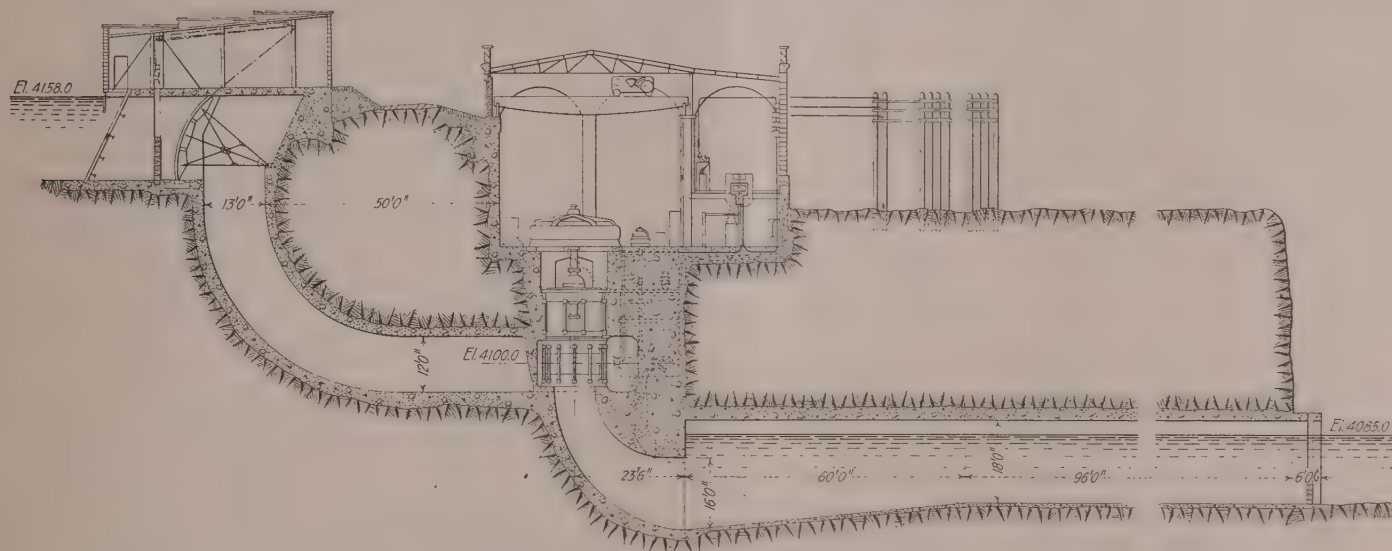
THE TYPE of canal lining for the Kananaskis Falls plant was carefully considered, four methods being proposed and studied. The power house was built mainly below ground level, principally to shorten the turbine shaft length and lessen vibratory effects.

CANAL LOCATION

The location of the canal was decided by the sinking of test pits. Rock outcropped from the Kananaskis River to the eastern edge of contour 4165. Beyond this the rock dropped off abruptly to between El. 4140 and El. 4137. Therefore El. 4140

canal is 670 ft., the last 60 ft. of which is constructed on a curve to join the forebay perpendicularly.

Four methods were proposed for lining the canal, due consideration being given to the fact that the sloping bank of the river was but a short distance away and the formation was mainly sand and gravel. The four were a gravity-section concrete wall; a vertical-section reinforced-concrete counterfort wall, a sloping-section reinforced-concrete counterfort wall, and a 4-in. lining of plain concrete laid on 12 in. of niggerhead riprap. The writer favored the third method for its efficiency, permanent



POWER HOUSE BUILT MOSTLY BELOW GROUND SURFACE TO SHORTEN TURBINE SHAFT LENGTH AND LESSEN VIBRATORY EFFECTS

Tunnel. This tunnel, built nearly twenty years ago, is about 5 x 7 ft. in section and penetrates some 2 miles into the hill through sandstone and shale of usually vertical strata. The tunnel has a rubble-masonry, watertight bulkhead about 2000 ft. from the portal, and through this bulkhead passes an 8-in. pipe which conveys water from the underground supply to the city reservoirs.

A valve in this pipe line near the outer face of the bulkhead is closed in the fall of the year when the city no longer has immediate need for water from this source, and during the winter the pressure behind the bulkhead rises rapidly. In the spring of the year a flow of 60 miner's inches can be drawn from the tunnel for a period of three months. It is estimated that the storage capacity tapped by this tunnel is 45,000,000 gal., in addition to the natural flow of from 25 to 30 miner's inches. The flow from the tunnel in the summer season continues to be 25 to 30 miner's inches after the capacity of the reservoir has been exhausted, and it has been found that the normal summer flow from the tunnel can be drawn off through the winter without decreasing the total quantity of stored water available for the following dry season.

was assumed as the bottom of the canal. Where the rock surface dropped naturally below this level, all dirt was cleaned off and backfilled with boulders and niggerheads to El. 4140. The requirements of design were:

That ample proportions be used so that under the most abnormal conditions the velocity of the water should not exceed $1\frac{1}{2}$ ft. per second; that the section through dirt, consisting of layers of gravel sand, loam and clay, should be lined with concrete on a slope; that the section through rock should be unlined and have vertical sides, and that allowance should be made in the section for the roughness of the surface; that ice pressure should be taken care of by putting a slope of 2:1 on the upper section of the lining, from El. 4153 to El. 4158, and that access should be easy.

DIMENSIONS OF CANAL SECTIONS

The section through rock was made 72 ft. wide with the bottom elevation at El. 4140, and through dirt it was made 50 ft. wide at the bottom, with the sides sloping 1:1 from El. 4140 to El. 4153, and 2:1 from El. 4153, the crest of the canal wall. Transitions were placed between the vertical and sloping sections. The total length of the

economy and ease of construction. The fourth was adopted.

OPENING TO TAKE CARE OF ICE

In the wall on the river side, adjacent to the head works, a decked opening 6 ft. wide was left as an ice run to clear the intake racks and keep the forebay clear of ice. A timber runway carries the ice and debris from this point to the river. The opening is closed with stoplogs.

Operation has shown that the lining on the river side is leaking considerably, and steps are now being taken to remedy this. It has also become clear that a 15-ft. opening on the center of the river canal wall would have been most serviceable in the removal of ice, which has a tendency to become very thick because of fluctuations in the pond level, and which exerts an enormous pressure on the canal lining in spite of its slopes.

INTAKE AND PRESSURE TUBES

To serve two main units and the exciter unit two pressure tubes were provided, with the dimensions so arranged that the maximum velocity at entrance would be 2 ft. per second, and the maximum velocity at entrance to the scroll chambers of the turbines 6 ft. per second. The intakes

were, therefore, made 35 x 13 ft., narrowing by easy smooth curves and lines to a 12 x 12-ft. section with filleted corners.

To support the upper lining at the curve upward to the intake, heavily reinforced pillars 3 ft. x 18 in. in the shape of sharp-ended ellipses, pointing upstream, were placed midway in each tube, and the shale in which the tubes were built was grouted.

WATER CONTROL

The intakes are served by two 15-ft. openings in the head works. The usual style of racks are placed in front of these openings. Back of the racks grooves are left for stoplogs, which form the final protection to the intakes. The main water control is effected through a system of four Tainter gates, two to each intake, each of which swings on a 2-in. steel shaft supported by eight bearings, which are separately anchor-bolted to concrete seats at El. 4142.48. The gate when fully up swings to rest against the slope of the back gravity-section wall, the top edge of the gate entering a space left for it in the floor, and chains being provided to tie it securely.

Closure between the face lagging of the gate and the concrete side walls is made by an 8-in. piece of $\frac{1}{4}$ -in. oil-tanned leather attached to the face edge by a brass bearing plate and lag screws. The mechanism for the operation of the gates and the control of the stoplogs is supplied by two double-drum winches attached to the columns. Steel cables run from each of these winches to the gate through sheaves, and by means of a bridge attachment to the gate any racking in raising is avoided.

DRAINAGE SYSTEM PROVIDED

A drainage system is provided to take care of any leakage through the gates or the stoplogs when they are down, controlled by flap valves operated by chains from the floor of the head works. Sluice gates 16 in. in diameter and the necessary passageways are also provided to fill the pressure tubes before raising the Tainter gates.

A warm building was constructed over the intake works of hollow tile plastered inside and out, with Fenestra steel arched

window sash. The roof is of 2 x 4-in. timber, on edge and set tight, with a Johns-Manville asbestos three-ply coating. The front wall of the building is carried on a 12-in. I-beam and a 12-in. channel attached to beams cantilevered out from the piers. This allows for a heavy wooden door to be hinged from the bottom of the 12-in. wall-supporting I-beam. The door projects into the water, to keep the weather out of the building, and also gives wind and ice freedom without danger to the



DRAFT-TUBE SECTION BEING SET UP

structure. The space between the cantilever beam is left open for convenience in raking.

POWER HOUSE

The two main turbines are of the vertical-shaft single-runner type, delivering 5800 hp. at 164 r.p.m. under a normal effective head of 68 ft. for 85 per cent efficiency at three-quarters gate, guaranteed to maintain normal speed and capacity under heads varying from 65 to 72 ft. and for the runaway speed not to exceed 280 r.p.m. at full gate and no load. Each main unit is controlled by a governor guaranteed to operate in parallel turbines provided with a different type of governor.

The exciter turbine is a 150-hp. single-

runner, vertical-shaft machine guaranteed for 82 per cent efficiency. The casing is of the cast-iron scroll type. Inlet pipe connections between the concrete scroll chambers of the main units and the cast-iron scroll are provided of cast iron and furnished with the necessary control valves. No flywheels are provided for the main units, because of the flywheel action of the rotor, but for the exciter turbine a flywheel is provided, since the exciter armature has small flywheel capacity. A self-contained oil-pressure-type governor is provided for this unit. The turbines and governors complete installed in place were supplied by the Canadian Allis-Chalmers Company.

The generators were designed to carry 25 per cent overload continuously, and will stand a momentary overload of 100 per cent and a dead short circuit for two minutes without injury. They were designed to operate successfully in multiple with the generators at the Horseshoe Falls plant.

BUILDING BELOW GROUND LEVEL

The power house is mainly below ground level. This shortens the turbine shaft length, lessens vibratory effects and saves considerable foundation concrete. The excavation was in solid rock, mostly shale, and to the bottom of the draft tubes was 100 ft. deep. The exciter-turbine draft tube, also formed in concrete, joins to the wall of No. 2 tailrace tunnel. The first lift of concrete was brought up $3\frac{1}{2}$ ft. short of the foundation ring of the turbine, which was set on concrete pedestals and fitted with its anchor bolts. The scroll chamber forms were made complete at the ground surface and swung into place complete by derrick. The concrete around the scroll chambers was strongly reinforced. A thrust deck chamber or floor is provided, access to which from the main floor is given by stairway. The inside dimensions of the power house are 90 x 60 ft. The west wall is of plain and reinforced concrete, the other walls being of plain concrete to the ground surface and hollow tile plastered from that point. The crane is carried on steel columns and on the concrete of the west wall. A gallery 20 ft.



EXCAVATION MOSTLY IN SHALE



LOWERING CHAMBER FORM

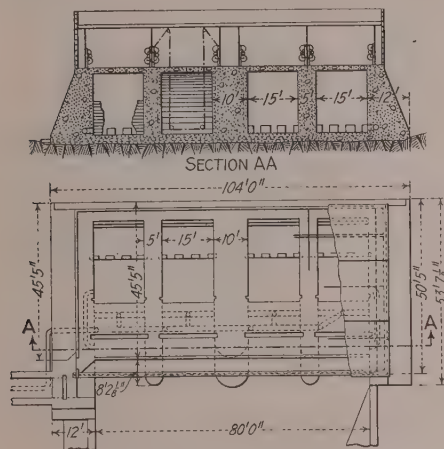


SCROLL CHAMBER COMPLETED

wide over 69 ft. of its length provides for the upper section of the bus structure and the electrolytic lightning arresters, and affords access to the line switches.

TAILRACE

As shown by the general section, the water is carried from the draft tubes through the tailrace tunnels each about 156 ft. long. The normal tailwater level is El. 4085. The inside crest of the tunnel arch was placed at El. 4088. The level of the bottom of the draft tubes is El. 4064.35. The tunnel section at this point was made 23.65 ft. high and 14 ft. wide with a semi-circular arch of 7-ft. radius. The floor rises from the end of the draft tubes to El. 4070.13 at a point 60 ft. distant, when the dimensions become 18 ft. high and 14 ft. wide, with the same semicircular arch of 7-ft. radius. The tunnels are driven through a soft, seamy shale and had to be



WATER CONTROL EFFECTED THROUGH SYSTEM OF TAINTER GATES

heavily timbered. They are lined with concrete of a minimum thickness of 9 in.

The work in its entirety was put through with the company's own forces. All the detail designing for the whole work had to be done as the work progressed, due to the limited time, and was under the writer's supervision, as well as all the field engineering.

At the time the plant was built H. A. Moore was general manager and chief engineer, C. W. Allen was superintendent of construction, and the writer was resident engineer. E. Barnes was general superintendent of operation. At the present time F. J. Robertson is general superintendent over both plants and to him the writer's thanks are due for help afforded in the preparation of this article.

AN ALUM SYRUP PLANT for the Omaha waterworks is now under construction, and Andrew Jacobson, chemist, states that the plant is expected to be put into operation by March, 1916. It is to be similar to the one in Columbus, described in the Engineering Record of May 8, page 576. Apparatus will also be installed to use the alum-iron process which has been developed at Omaha. By a combination of the two processes decided reductions in the cost of coagulation are expected. Charles P. Hoover, inventor of the alum syrup process, saved Columbus \$6000 for the city during the first nine months of the present year. Flint, Mich., will soon be using a similar installation in connection with the filter plant.

Leonard Metcalf Suggests Improvements in Public Utility Control and Valuation

Constructive Measures Advocated for Simplifying Litigation and Co-ordinating Efforts of Commissions and Corporations

HIGHER standards of fitness for the personnel of public service commissions, reasonable control rather than dictation of operating policies, and departures from ordinary legal methods of trial are a few of the measures advocated by Leonard Metcalf, in his presidential address before the New England Waterworks Association Jan. 12, for improving the relations between public utility corporations and regulating boards and for reducing the unwarranted high cost of litigation and waste time in cases of valuation and rate-making. In the rating case of the Spring Valley Water Company in San Francisco Mr. Metcalf cited certain modifications of court procedure in segregating evidence of different classes and allowing an exchange of questions among experts on both sides, which halved the time ordinarily consumed in such cases. As a general rule governing the operation of public utilities, Mr. Metcalf said, liberal rates for adequate service are preferred by the public to lower rates for poor service. It is well, too, to bear in mind that good service cannot long follow inadequate returns.

DANGERS OF COMMISSION CONTROL

After emphasizing the desirable features of commission control Mr. Metcalf pointed out certain of its shortcomings. The intrusion of politics is an ever-present danger—the bringing of political or corporate pressure to bear upon individuals where judicial considerations alone should govern. Lack of experience in the construction and operation of public utilities on the part of some men who have been appointed to the commissions, and more particularly of some of the engineering staffs appointed by them, has already resulted in litigation and expense which would have been avoided had these men but had greater experience in the actual difficulties and hazards of construction and operation. Commissions, however, have been seriously hampered through lack of appropriations to command the services of men of mature judgment and breadth of experience in the operation as well as the design and construction of public utilities. Moreover, the uncertain tenure of office in such work has sometimes militated against the commissions and the public.

HIGH COST OF LITIGATION

The lack of breadth of experience of men employed by the commissions in the valuation of public utility properties sometimes causes burdensome expense of litigation. This results from the fact that men of experience often can arrive at results, by methods of approximation growing out of the breadth of their knowledge and experience, which would be equitable, authoritative and acceptable. Thus the extent and cost of preparation of evidence would be confined to narrow limits, whereas with lack of experience on the part of the commission or of its staff, the corporations and the representatives of the public feel it necessary to present evidence in great detail, to make clear to the inexperienced reviewer the force of their claims.

It is clear that if appealed cases become numerous the cost of the utilities' service to the public will necessarily be increased thereby. In waterworks valuation and rating cases the joint expenses of trial to the parties at issue have often amounted to from 10 to 15 per cent of the total value of the property.

Not only have courts, commissions and arbitration boards recognized the burdensome character of this expense, but also lawyers and experts. Conscientious effort has generally been made by the latter to eliminate by agreement, in advance of the trial, as many of the issues at bar as possible, with a view to decreasing unnecessary expense. Often it happens in court trials that while both parties may in good faith desire to bring about such agreement, the political situation may make it practically impossible to undertake it without running the danger of possibly having the subsequent decision called into question by reason of such joint effort. In these cases, the public utilities commissions are in a position to be of marked service to the parties at issue.

TIME-SAVING METHODS

Some interesting and significant departures have been made from the ordinary legal methods of trial with a view to decreasing the expenses involved in such litigation. In the valuation of the waterworks property of the Macon Gas, Light & Water Company, the board of seven arbitrators, consisting of five engineers and two bankers, outlined and adopted the following course of procedure in the interest of economy of time and expense: First, counsel opened with a historic sketch of the situation; second, the witnesses of the corporation and then of the city stated their qualifications, the nature and extent of their investigations, and their findings, briefly and without the intervention of counsel, either in direct or cross-examination; third, counsel on both sides then discussed intangible or semi-intangible values; and, finally, any witnesses desired were recalled by the board at the request of counsel on either side, for cross-examination. This program outlined proved acceptable to the parties at issue. The trial was concluded in two weeks at a cost of about 3 per cent of the amount of the award, instead of 15 per cent, more or less, which might have resulted had the ordinary legal methods of procedure been followed.

SPRING VALLEY CASE SIMPLIFIED

Similarly, the procedure before some of the public utilities commissions is conducted on informal lines, instead of by categorical question and answer with explanation. Also the witness is interrupted by the members of the commission at will in order to make clear, as they arise, any doubtful points and to bring home to the witness any considerations overlooked, which might influence his judgment. Last year the master in chancery of the Federal Court of the District of California, Hon. H. M. Wright, in the trial of the Spring Valley Water Company rating cases at San Francisco,

modified the ordinary order and methods of court procedure, first, by hearing all of the evidence upon real estate values before admitting evidence upon structural values; second, by hearing the evidence upon structural plant; and then by having all of the experts give their evidence, simply and in the form of a connected story unaided by counsel, upon a single group of property, such as earth dams, or pumps, or conduits, and by permitting counsel to cross-examine the witnesses after the giving of this testimony and before taking up the next class of items. The experts upon the one side were at liberty to question the experts of the other and to assist the court by statements of their own experience, in the nature of rebuttal, in reply to and as tending to meet the statements of the other experts. The plan worked admirably and the master has said that the time consumed has probably not been over one-third to one-half as great as it would have been if the ordinary methods of court procedure had been followed. Furthermore, the master was thus able to form judgment fairly conclusively upon the various phases of the case as the evidence was adduced, and while the subject was still freshly in mind, instead of being obliged to carry an enormous mass of detail and review the previous testimony.

LIMITING TESTIMONY

In a recent hearing before Judge Sessions at Grand Rapids, upon the suit of Ann Arbor vs. State of Michigan, the court limited the introduction of evidence and expenditure of time in the trial, by limiting the cross-examination practically to questions touching upon the qualifications of the witnesses, their honesty of purpose, the soundness of the theories advanced by them, and only the major items entering into the estimates of the engineers. The court refused to consider petty items as likely to have little effect upon the decision. The trial was concluded in six days, which is certainly a remarkably brief hearing for a case involving property values of \$10,000,000, more or less. It is of significance, however, as indicating the viewpoint of the court upon methods of trial and the desirability of considering these problems upon broad lines, rather than in petty detail. This case again brings into prominence the necessity for the review of such questions by men of breadth of experience in the construction and operation of such properties.

Another departure which has been suggested is to be found in the appointment, by the court, of a disinterested engineer of experience to aid it in the formation of sound judgment—in effect, calling the engineer to sit upon the bench with the judge to pass upon technical matters and to aid in limiting the lines of investigation to matters of fundamental importance and weight.

The observations here made upon court trials apply in some measure to trial by commission and serve to accentuate the desirability of having competent engineers, as well as lawyers and business men, appointed to our public utilities commissions. The engineering, as well as the legal, point of view is of great importance in assisting to an expeditious and equitable solution of public utilities problems.

DICTIONARY VERSUS CONTROL

If our commissions are to dictate policies they will require greater opportunity, better facilities and far greater financial support to form and exercise sound, far-

sighted judgment. If they then dictate the policies to be pursued in management of the public utilities, the corporations should be relieved of the hazard incident to the enforcement of these policies. If, on the other hand, the corporations are still to be made to bear all responsibility and hazard, they should be given reasonable latitude in determining policies and the demands of future service, and should be accorded rates of return commensurate with the hazards involved in their business.

ADEQUATE VALUE

The failure to place adequate value upon public-utility properties or to make proper allowance for appreciation in value; the elimination of portions of the property from the rating base, as not actively and immediately necessary to the service of the public, and the reduction of the rates to a point which will not produce a return fairly commensurate with the hazard of the business and in keeping with rates of return prevailing thereabout in other classes of enterprise, all carry with them real dangers to the public, the character and ultimate result of which the public little realizes. Thus, if the difference in value between the mere assemblage of the structures and real estate, "the bare bones of the property," and the living, going concern, with established profitable business—which it has involved time, effort and real cost to develop—be not fully recognized; if spare machinery, reserve structures and reserve properties held for the service of the public or bought for use in the reasonably near future, be excluded from the rating base, or if the rate of return fail to provide reasonable depreciation allowance as well as fair return commensurate with actual hazard, the final result is much the same. The commission may temporarily determine operation and values even to confiscation of a portion of the property value and cutting off of the market for the corporations' securities, but in the long run economic principles will control and this inevitable cycle will follow: Declining service, inadequate service, inability to borrow new capital, and, finally, withdrawal of capital from new enterprises.

If public ownership be the real goal sought, a more direct method of approach would effect a saving in the ultimate cost of acquisition of the desired properties. But various recent occurrences indicate that the general public is by no means prepared as yet to embark upon municipal or government ownership and operation of public utilities, generally or upon a large scale.

It is well recognized by intelligent managers that the public will more cheerfully pay liberal rates for adequate service than lower or even inadequate rates for bad service. Under normal operating conditions the rule is, "Look to your service first; fair rates will follow," though it is equally true that good service cannot long follow inadequate return.

THE REMEDIES

Promising remedies for the dangers and abuses cited may be summed up as follows: 1. Nonpolitical appointments and freedom from political or corporate pressure or control for the public service commissions and their staffs. 2. Long tenure in office. 3. Higher salaries, adequate to attract and hold men experienced in corporate affairs and in the construction and operation of public utilities. 4. As brief

and direct methods as possible of establishing value and fair rate of return. 5. Reasonable regulation or control of the utilities by the commission rather than dictation of operating policies. 6. Broad and fairly liberal treatment of the question of value and fair rate of return, particularly in the transition stage from no regulation to full control. 7. Support by the public of disinterested and sound findings in public utility disputes made by competent tribunals, commissions or men—whether these findings bear heavily upon the corporation or fail to meet public expectation.

Many people have a tendency to lose sight of the judicial or impartial stand which commissions should take and to think of them mainly, if not solely, as agencies for reducing rates. The true function of a public service commission is to act as a referee, charged with seeing, on the one hand, that the public has to pay no more than a fair price for the service rendered, and that it receives service of the character for which it pays; and, on the other hand, that the utility receive fair treatment and compensation. The public, and the corporation as well, can derive benefit only from the regulation of utilities by an able and impartial commission. This is equally a fact whether the utilities be owned by corporations or by the public themselves; and the writer would not be surprised to see the jurisdiction of the commissions more generally extended in the near future to cover matters relating to the accounting, financing and making of rates of municipally-owned utilities.

Holland Develops New Types of Shore Protection

Reinforced-Concrete Beams and Slabs Used Extensively in Groins in Late Years—Only Partly Successful to Date

PROBABLY no other country has been forced to fight against the inroads of the sea to the extent that Holland has. The peculiar geographical and topographical conditions, with dikes or dunes protecting the lower land behind them, the wide tidal range, the prevalence of severe storms have all made imperative the study of the best methods of shore protection. In his memorable article, "The War Against the Waves," published in the Engineering Record of April 11, 1914, page 408, Dr. Elmer L. Corthell, consulting engineer, discussed at considerable length the protective devices in use in Holland, as well as elsewhere. Since his study abroad, however, there have been new developments. A recent report to Dr. Corthell from John W. Thierry, of Haarlem, Netherlands, which Dr. Corthell in turn transmitted to the recent Pan-American Scientific Congress, as a discussion of the paper by B. F. Cresson, Jr., on "The Protection of Sandy Seashores," gives much data relative to new departures in groin construction. A characteristic feature is the growing use of reinforced concrete. In some forms this has already justified itself. In others the experiment to date has been unsuccessful. These notes are taken from Mr. Thierry's paper.

ONLY GROINS ARE SUCCESSFUL IN HOLLAND

In Holland groins have proved the only successful means of flattening the shore and consequently raising the feet of the dunes. Even these have not always proved

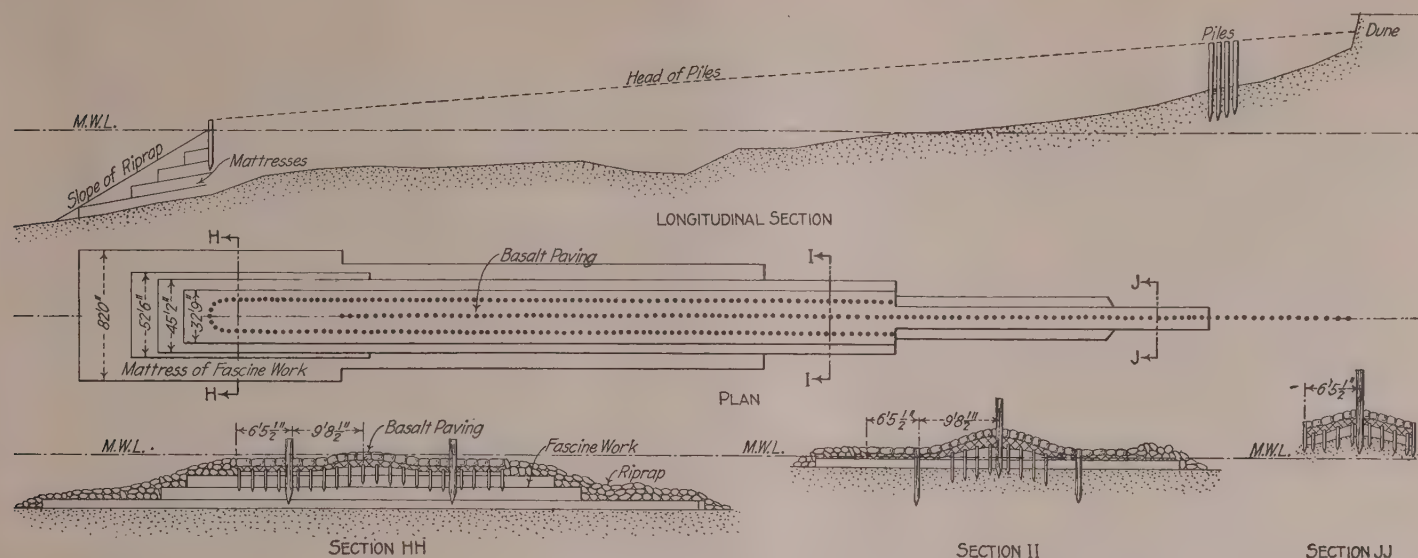


FIG. 1—FASCINE MATTRESSES AND BASALT PAVING CHARACTERIZED THE CONSTRUCTION OF 1895 TO 1902

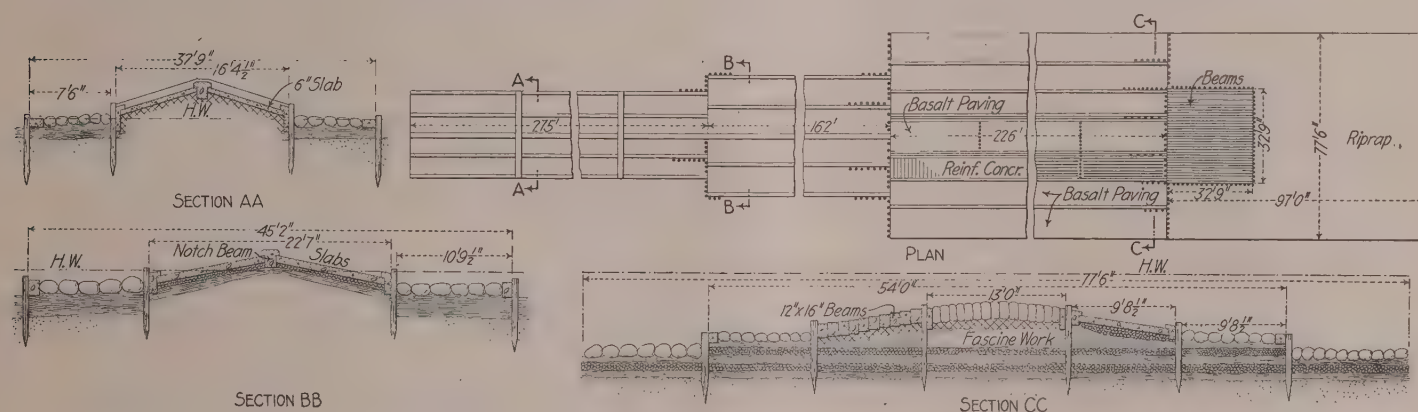


FIG. 2—REINFORCED-CONCRETE BEAMS AND SLABS, AS FIRST USED IN 1906, HAVE PROVED VERY SUCCESSFUL

successful, as some sections of the coast, though defended by groins, have continued to decrease. This points to the fact that the groins were not long enough, and two remedies have been applied: Retiring before the sea, that is, extending the groins landward; and attacking the sea by extending them seaward. The latter method is much more expensive, but is more effective, and is imperative where the dunes are too narrow to permit any further loss.

Beginning in the eighteenth century forty-six groins have been built along the Dutch coast between Hook van Holland and Scheveningen, a distance of 21 km. (about 13 miles). Fig. 1 shows details of the latest six of these, built between 1895 and 1902. Despite the groins the shore near Ter Heide continued to recede, and the landward-extension method was used, until hardly any dunes were left. Then the other form of extension was adopted. A succession of fascine mattresses was laid from the outer ends outward and paved with basalt blocks as in the original design. The lowest of these mattresses was 132 ft. wide.

REINFORCED CONCRETE PROVES SUCCESSFUL

Reinforced-concrete beams were adopted in 1906 at the Hondsbossche Dam in place of the basalt pitching or paving for the side parts of the groins. They can be used only where they can be shut up between piles. Fig. 2 shows details of a new groin constructed at this point in 1912. Both reinforced-concrete beams and reinforced-concrete slabs were employed. At the landward end the center beams disappear

and the middle part is composed of concrete slabs held by a notch beam and groove beams.

The groin was very successful in building up the beach. During a severe gale last winter, however, it was severely dam-

aged. For a distance of 200 ft. all of the beams in the narrowest section were torn away. Probably the heavy wave impact transmitted through the interstices between the beams lifted up the notch beam. Consequently all of the beams worked loose

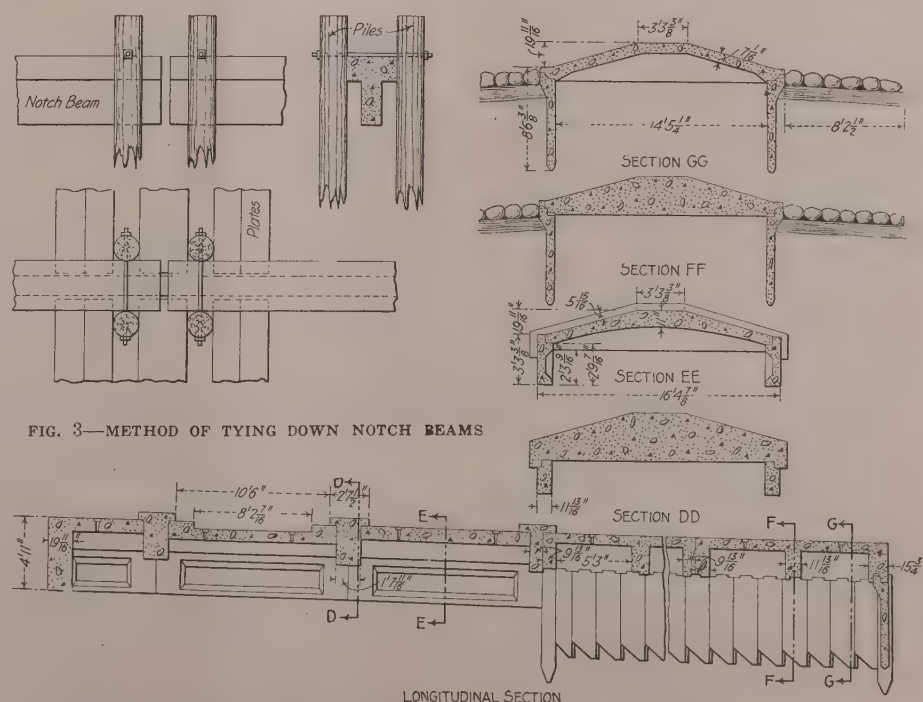


FIG. 3—METHOD OF TYING DOWN NOTCH BEAMS

FIG. 4—THESE FORMS OF CONCRETE CONSTRUCTION, PLACED IN 1910 AND 1912, HAVE NOT BEEN WHOLLY SATISFACTORY

and were thrown up on the shore. Within six days, however, the whole groin was repaired with the old beams, only six or seven of which were broken or lost. To prevent recurrence of the damage the notch beams were tied down with $\frac{3}{4}$ -in. rods connecting piles driven into the body of the groin at the ends of the beams, as shown in Fig. 3.

RECENT CONCRETE VAULT CONSTRUCTION NOT SATISFACTORY TO DATE

In 1910 there was applied to the land end of the groins a reinforced-concrete construction consisting of slabs in the form of a vault, supported by side beams and kept in place by heavy cross beams. Under the side beams were beams of fascine work. This construction was not a success, as the gales undermined the fascines and threatened the side beams. Consequently the seaward end of the land section was changed in 1912 in the new groins to the design shown

in Fig. 4. Over a length of about 50 ft. the beams were replaced by sheet piling. Side beams were retained for the remainder of the inner end, and the figure shows details of both types. During the last winter, however, the side beams landward of the sheet piling were severely injured, and it was decided to turn back to the fascine construction.

There is a remarkable phenomenon connected with the construction of groins on a sandy shore. The unprotected shore at the ends of a set of groins is eroded more strongly after than before the coast was defended. This is probably caused by the currents along the coast, which are diverted from their course by the groins, and which, when they have reached the last groin, turn toward the shore and erode it. Because of this the provincial government of Zuid-Holland has forbidden the lengthening of any more groins on the Delfland coast.

to assist in various ways. He points out the facts that the present stagnation must gradually be overcome and that there is little doubt but that the arid lands of the West will be utilized ultimately to the full extent of the water supply. There will be a gradual extension of the acreage by individual or community effort and by private agencies, but the development of the larger projects must rest upon some method of co-operation to be worked out between the public and private agencies—one involving a high degree of public supervision and some contribution of public funds, the latter not to be repaid directly. Here is the crucial or danger point, namely in the distribution of subsidies of this kind giving rise to the "pork barrel" allurements. The author makes clear the need and limitations of future growth which will inevitably follow unless some wise contributions are made directly or indirectly out of the public purse.

The book is the result of many years of study of the subject in connection with the investigations of the Department of Agriculture and of the Census, making available in convenient form the larger conclusions derived from these very elaborate undertakings.

Literature

For the Civil Engineer and Contractor

New Publications

REPORT OF THE CHIEF OF ENGINEERS OF UNITED STATES ARMY to the Secretary of War, 1915. Paper, 6 x 9 in.; 1727 pages, with 48-page index; illustrated. Washington, Government Printing Office.

ELECTROLYSIS AND ITS MITIGATION. By E. B. Rosa, chief physicist, and Burton McCollum, electrical engineer, Bureau of Standards. Technologic Paper No. 52. Paper, 6 x 9 in.; 143 pages; illustrated. Washington, Government Printing Office.

THE STRUCTURE AND PROPERTIES OF THE MORE COMMON MATERIALS OF CONSTRUCTION. By G. B. Upton, assistant professor of experimental engineering, Sibley College, Cornell University. Cloth, 6 x 9 in.; 327 pages; illustrated. New York, John Wiley & Sons, Inc. \$2.50 net.

EARTH RESISTANCE AND ITS RELATION TO ELECTROLYSIS OF UNDERGROUND STRUCTURES. By Burton McCollum, electrical engineer and K. H. Logan, assistant physicist. Technologic Paper 26, U. S. Bureau of Standards. Paper, 7 x 10 in., 48 pages; illustrated. Washington, Government Printing Office.

CITY PLANNING WITH SPECIAL REFERENCE TO THE PLANNING OF STREETS AND LOTS. By Charles Milford Robinson. Reissue, revised with much additional material, of the original work entitled, "The Width and Arrangement of Streets." Cloth, 6 x 9 in., 344 pages; illustrated. New York and London, G. P. Putnam's Sons. \$2.50.

REINFORCED CONCRETE CONSTRUCTION—Vol. 3. Bridges and Culverts. By George A. Hool, associate professor of structural engineering, University of Wisconsin, assisted by Frank C. Thiessen, instructor in structural engineering, University of Wisconsin. Cloth, 6 x 9 in.; 688 pages; illustrated. New York, McGraw-Hill Book Company, Inc. \$5 net.

THE BROAD PASS REGION, ALASKA. By F. H. Moffitt. Bulletin 608, U. S. Geological Survey. Paper, 6 x 9 in. Washington, Government Printing Office. Description of the topography and geology of the Broad Pass Region, Alaska, based on work carried on by the U. S. Geological Survey since 1913. Prepared "in anticipation of the probable demand for information about this region because it is traversed by the new government railroad connecting the Pacific Coast with the interior of Alaska."

Books Reviewed

Irrigation in the United States

Author, Ray Palmer Teele, M. A., Irrigation Economist, Office of Public Roads and Rural Engineering, United States Department of Agriculture. Cloth, 5 x 7 $\frac{1}{2}$ in.; 251 pages. New York and London, D. Appleton & Co., \$1.50.

REVIEWED BY F. H. NEWELL

Head of Civil Engineering Department, University of Illinois, Urbana.

That "the writer knows of no subject on which there is more public misinformation than the subject of irrigation" is the key-

note of this book. Mr. Teele endeavors to present in a clear, readable form some of the elementary facts which will remove much of the misapprehension concerning this subject. Had this little book and the information it contains been available to engineers and investors two decades ago, it would undoubtedly have saved the loss of many millions of dollars. It is not too late, however, for its value to be appreciated.

Proceeding from the elementary historic statements and description of climatic conditions in the arid regions, there is taken up the matter of water supply and crops, but the principal part of the work and one which gives the largest amount of original information is under the head of legislation, irrigation investigations and the organization and operation of irrigation enterprises. A clear but simple analysis of these is given, and it is shown that "the financial success of a project depends upon rapid and successful settlement of the lands to be reclaimed."

In considering irrigation investments, Mr. Teele calls attention to the fact "that the harm has come from the sale of such bonds to small investors on false representation, that they are, in the case of districts, municipal bonds backed in some way by the states and counties, and in the case of irrigation bonds that they are liens on the lands and are backed by the states and the Federal Government."

The long and involved history of these irrigation investments is condensed into readable form; every engineer may learn a useful lesson not merely with respect to irrigation enterprises, but regarding many other projects which appeal to popular enthusiasm. In the past the engineers have been too negligent of this important phase of the works in which they have been employed and have neglected, to their own detriment, the study of the financing of these and the danger which comes to the public through recklessness in the promotion of half explainable schemes.

In conclusion the author discusses the present and future of irrigation and the duty of the Federal Government to continue

Maintenance of Way and Structures

Author, William C. Willard, assistant professor of railway engineering, McGill University. Cloth, 6 x 9 in.; 451 pages, 232 illustrations. New York, McGraw-Hill Book Company, Inc. \$4 net.

This is a work for which there has been a great need. Maintenance-of-way literature in book form has been confined to a handful of books. Two or three of these were good when issued, but have not been kept up to date. Furthermore, they were detail discussions, suitable for the reference shelves of the practising engineer, but not for textbooks. Two or three more recent works have been written especially for the classroom, but have fallen short technically. Professor Willard, however, has succeeded in producing a combination work not too voluminous for student consumption, yet technically sound and useful for the roadmaster's library.

Having said this, the reviewer cannot hold back a little pity for the student who must absorb the book; he wishes less of an encyclopedia and more of a human document could have been produced. Whole pages of rules of the American Railway Engineering Association, and conclusions from special investigations, are printed verbatim, with none of the journalistic effort to discard the shell and save the kernel only. Much dry statistical matter is run into long paragraphs, sparing use having been made of tables. The author's expressed opinions are few, the unsophisticated student getting little help as to the choice between two or more types or systems in use. The reviewer does not believe the student called upon to study the book will forthwith become a maintenance enthusiast. Practising maintenance engineers will want it on their shelves, because, as previously stated, the supply of literature on the subject is limited and this is no half-prepared work—but they will keep it for reference, not for recreation.

After a short introductory chapter arguing the importance of the subject the author takes up organization. He sets forth the characteristics of the departmental and divisional systems, but does not state his choice,

although his students will presumably ask him which is preferable. He gives detail rules of conduct that could probably be deferred to a poster in the division office.

Chapters 3 to 10 inclusive, with chapter 16, which relates to switches, frogs and turnouts, embrace practically everything that goes to make up track—roadbed, ballast, ties, rail and track fastenings—and do so in comprehensive fashion. The importance of drainage is well brought out. Sundry statistical matter relative to ties, such as the percentages of track in America laid with ties of various dimensions, could well have been tabulated or omitted. A chapter is given to timber preservation, and here the author is probably wise in withholding his opinions. In the chapter on turnouts the author is to be congratulated for having omitted the usual useless matter on circular turnouts.

Chapters 11 and 12 deal respectively with stress in track and the design of track. The author tells considerable about prevailing axle loads and speeds, and gives mathematical demonstrations of impact and the like, but when the student reaches the end he will perceive that somehow he has not learned how to translate these things into something tangible to help him design track. The author would have been kinder if he had let the student into the secret—that this has not been done yet, and that a joint committee of two national engineering societies is trying to learn how to do it.

Chapters 13, 14 and 15 cover respectively signs, fences and crossings; accessories to track (buildings, engine terminals, water tanks and so forth); and bridges, trestles and culverts. The author's conservatism of opinion is shown in the section on engine houses, when he says they "may be either circular or rectangular," with no intimation that the one is the rule and the other the exception. He fails to bring out what constitutes an engine terminal in its entirety, and says nothing about yards, probably for the same reason he gives for omitting signals, because the subject is too big to be covered adequately here.

Chapter 17 sets forth the various classes of maintenance work necessary, and times and manner in which they should be done. This chapter is straightforward and free from fine-print rules, and is a useful one for students. The last chapter, chapter 21, which discusses the annual program and should perhaps come next, reverts to some extent to undigested fine print. Chapter 18, on machinery, tools and supplies, gives detail dimensions of everything from brooms to hand cars, and pictures and descriptions of larger work equipment.

Chapters 19 and 20 have to do with records and accounts, and in the former is a presentation of the requirements of the Interstate Commerce Commission regarding maps and profiles for the valuation work, and also of the requirements of the Board of Railway Commissioners of Canada.

One maintenance development that the author seems to have missed entirely is the unit system, developed on the Pittsburgh & Lake Erie, Baltimore & Ohio and other roads.

In conclusion the reviewer would merely repeat his opinion that the book will be heavy and uninspiring reading for the student, but that it is carefully prepared and technically accurate in the main, and should prove an excellent reference book. Even as a text it is far better than one which merely skims the surface and is inaccurate.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Brooklyn's Fill-and-Draw Tank Not a Small One

SIR: I should like to call attention to a statement in your issue of the first instant, under the heading "Activated Sludge Sewage Treatment."

The statement that the fill-and-draw experiments on activated sludge conducted by the Brooklyn Bureau of Sewers were on a small scale tends to convey a somewhat misleading impression. Our fill-and-draw tank was second in size only to the Fowler tank at Milwaukee, being of 16,000-gal. capacity as against approximately 25,000 gal. in the latter case.

I think it must be granted that this is somewhat more than a small-scale experiment.

WILLIAM T. CARPENTER,
Bureau of Sewers.

Brooklyn, N. Y.

Decimals of the Degree and of the Full Circle

SIR: During the past half year or so your journal has contained considerable discussion of the decimal division of degrees, this subject having been revived by the publication of Professor Raymond's "Field Manual for Civil Engineers." Possibly you will tolerate further mention of this matter.

While none of us can expect to survive until the day of the general use of the decimal system, there should be unqualified encouragement of all moves in the right direction. The majority of our units of measure seem to have been chosen by guess to the great inconvenience of every one who must use them. Since so many tables are necessary in the uses of angular measure, the change from the established bad practice will be a slow one. The adoption of the decimals of a foot in steelwork and similar construction is a change which could be accomplished far more readily, yet we go merrily ahead surveying to thousandths of a foot and designing bridges to fractions of an inch. But since one desirable improvement has been inaugurated, there is some hope for final relief from the nerve-racking and unproductive work of reducing our major units of measure to their clumsy subdivisions.

Instrument manufacturers could improve their product and, at the same time, give substantial aid in simplifying surveying computations if they would equip their transits with one vernier plate which would give decimals of a degree. An engineer would be reluctant to buy an instrument which would not read to minutes, since his work would frequently require this division. But he could feel free to adopt the more reasonable division on new work if his instrument were so arranged. The focusing screw could be placed on the side of the telescope in order to be equally serviceable to the two directions of the instrument. Also, the manufacturers could offer to sell new vernier plates to fit old transits of their make. One such plate on an old transit

would make the instrument available for the new system without robbing it of any of its present usefulness. While such a vernier plate would possibly be too long for the space allowed in the instruments as now constructed, such plates to be supplied for old transits could consist of a half vernier on each side of the zero in the manner common to the verniers of vertical circles.

Concerning the decimal division of the circle, little need be said. However, mention of two points should brand this idea as being superfluous. First, we seldom have occasion to consider any unit of measure in its relation to the whole circle. Besides, the substitution of a new main unit for the degree would lead to endless confusion during the process of the change while both units would necessarily be in common use. Second, no decimal part of a circle would be a convenient unit for transit use. The hundredth part, 3.6 deg., is too large and the thousandth part, 0.36 deg., is too small for the main division of the transit plate. This latter unit is too large for the smallest reading of the vernier, and one-tenth part of this, 0.216 min., is too small. On the other hand, the hundredth part of a degree is a very fitting subdivision for the vernier of a modern transit.

It might be added that with a vernier plate as suggested hundredths of a degree could be read as easily as minutes are read now. The vernier would be longer, the single scale being 24½ deg. in length as compared with the 14½ deg. of the present type, but the extra length would introduce no difficulty in the construction of the instrument.

LEONARD C. JORDAN,
Heffley School of Civil Engineering.
Brooklyn, N. Y.

Self-Dumping Scows

SIR: I note in your issue of Jan. 8, page 60, an article on "Filling Scows to Dump Them," and would state that during the First American Intervention in Cuba, as assistant superintendent for the department of street cleaning and parks in the City of Havana, I devised and built dump scows which were used from about 1901 until 1910 to take the garbage out of the city to sea and dump it. These scows may still be in use, but I am not sure. I obtained a patent for this scow and presented it to the City of Havana.

The scows used were about 100 ft. long, 30 ft. wide and 10 ft. in depth. They were decked scows, and the load was carried upon the deck. There was a longitudinal watertight bulkhead running through the middle of the scow with a shutter valve in one end. There was a 12-in. gate valve in the end of one of the compartments. The valve stems for both the valves were carried to the deck, so that the valves could be opened and closed from there. These scows were loaded with about 300 tons of garbage, towed to sea, and the sea valve opened to let in water enough to dump the load. The sea valve was then closed and the shutter valve opened to right the scow, which was then towed back to its place

and pumped out, using fuel obtained from the garbage.

Before the use of these scows, from twenty to thirty men were sent out with each scow and the garbage dug off. This took about three-quarters of a day, and during stormy weather often could not be done at all. I have seen eight scows, some of them rented at \$35 a day, lying loaded with garbage in the harbor of Havana. The self-dumping scow went out in all weather, took less than five minutes to dump, and there were no accidents.

T. WARREN ALLEN.

Washington, D. C.

To Trisect an Angle

SIR: It is with some astonishment that I see so gravely presented in the Engineering Record of Jan. 8, page 57, the solution of the trisection of an angle by compass and straightedge. I had thought the fact better known that this problem is in the same category as the squaring of the circle. The method shown is, of course, merely an approximation, whose degree of correctness is dependent on the given angle.

As the practical trisection of an angle can be readily effected in a few minutes by successive approximations with a pair of dividers, why this waste of time and space in the vain pursuit of the demonstrably impossible geometrical solution?

G. B. PILLSBURY.

New London, Conn.

SIR: The letter by Lieut. Natal Arnaud on the trisection of the angle which appeared in the Engineering Record of Jan. 8 greatly surprises me. Lieutenant Arnaud gives what he calls "another solution of the problem." It is a familiar fact that the trisection of the angle is (like the problems of the quadrature of the circle and the duplication of the cube) impossible by the use of ruler and compass alone.

The "solution" of Mr. Arnaud can therefore best be a rough approximation to the actual solution of the problem of trisection—an approximation which may, however, be of some practical value.

Looseness of statement in matters of this sort is to my mind inexcusable, and I think it is desirable to call attention to this case lest some of your readers be left under a false impression concerning the problem of angle trisection.

ALBERT LOUIS WECHSLER,
Columbia University.

New York City.

[Lieutenant Arnaud's method was published merely as another interesting attempt at the impossible.—EDITOR.]

Engineers' Technical File

SIR: The article by Louise B. Krause in your issue of Dec. 18, page 760, is interesting, but the system fails at the point where all the short cuts do; namely, in locating items of information not indicated by the general titles of articles in the technical periodicals. What I mean may best be indicated by a specific case, which is used for convenience because it is just at hand, though it is hardly typical of the kind of information that may appeal to engineers of experience.

In an article describing the Wallace plan for the elimination of grade crossings in Dallas, Tex., is the statement that crossing

gates and bells cost \$400 per crossing and that the cost of watchmen is \$1,000 per annum. The only way that item of information could ever be found again would be by indexing it either in a card index under "Crossing Gates" or in a loose-leaf notebook under the same heading. In, say, two years from now, if one were looking for information on the costs, or costs of operation of crossing gates, one might run across it by looking up all the articles on grade crossings, but as these are almost innumerable this latter is practically buried if not indexed, and the argument applies whether the article be clipped and filed or whether the volume be filed and no matter what facilities exist for finding the article by the title.

The writer has found no short-cut system for filing that would enable detailed information of this character to be found more easily than by compiling one's own index (practically as some form of the Dewey decimal system) with sufficiently minute sub-divisions to cover the ground, and by doing the work necessary to keep it up to date. A small up-to-date file is better than none, but unless a file and index system is quite complete, it will generally be found to contain everything but the thing which is wanted now. My own experience has convinced me that even with the aid of a secretary, who must be a person of some intelligence, it means a certain definite amount of personal work on my own part at least to indicate that part of the vast volume of technical writing which it seems necessary to index in order to keep up to date. Most often when these things are needed there is no time for painstaking search, and it is quite as often that it is some minor detail that refuses to be found and causes trouble as the solution of a great problem.

F. LAVIS,
Consulting Engineer.

New York City.

[Miss Krause makes the following reply to the letter of Mr. Lavis.—EDITOR.]

SIR: The copy of the letter from Fred Lavis to the Engineering Record, commenting upon my article in your issue of Dec. 18, has been duly received. I appreciate the opportunity you have given me of making the following reply to Mr. Lavis' criticism:

To state the case briefly, Mr. Lavis thinks that the system of subject indexing technical data advocated in the writer's article fails, in that it does not provide a method of finding "items of information not indicated by the general titles of articles in the technical periodicals." This criticism is not justified, as careful reading of the article will show that it very plainly advocates making as many specific subject entries as is desired. To quote from the article in question: "Each piece of data should be indexed under its most specific subject heading and not under a broad term which includes several definite divisions of a general subject. It should be indexed not under one subject only, but under any other subjects on which it gives useful information." This statement not only was made in regard to subject indexing of manuscript data, but also was repeated in regard to printed and periodical information.

The writer of the article might possibly have elaborated the explanation in order to show the application of this principle in making just as many analytical subject entries to any article as the engineer desired, but did not think it necessary, as the infer-

ence seems entirely plain. It did not seem necessary to state the fact which should be well known, that *subject* indexing never takes into account the wording of the title of an article, but is concerned only with the exact subject content of the article, no matter by what title name it may be called.

Mr. Lavis states that in his judgment the best system for filing is "to compile one's own index (practically some form of the Dewey decimal system)." In making this statement Mr. Lavis is undoubtedly clear as to its meaning in his own mind, but his use of the word "index" in this sentence is apt seriously to mislead and confuse the general reader. The Dewey decimal classification is a numerical system for classifying and filing all material on the same specific subject under the same number.

What Mr. Lavis means is that he approves of copying on catalog cards the gist of certain data on particular subjects, giving the references as to where they can be found in full, and then classifying and filing these cards according to a decimal subject system. This arrangement of the cards makes what is called a *classified* subject index, and should not be confused with the *alphabetical* subject index advocated by the writer. The writer recommends a straight alphabetical index of subjects arranged like words in a dictionary and which serves to indicate where the desired information may be found without having assigned to it a subject classification number.

The gist of the matter under discussion is, therefore, that Mr. Lavis does not agree with the writer in advocating a simpler and less complicated system for filing and indexing, but this is only a matter of a difference of opinion and does not mean that the system which Mr. Lavis does not approve is a failure because it does not give satisfactory results. Readers of the article in the Engineering Record of Dec. 18 will note that the writer does not disapprove of the use of the Dewey decimal classification (in fact, is using it every day), but is only describing a simpler and entirely satisfactory way for an engineer to handle his personal material when he does not have the help of a library expert to guide him through the intricacies and difficulties attached to the use of any subject scheme based on the Dewey decimal classification.

The writer heartily agrees with Mr. Lavis that the indexing of engineering data should be minute, accurate and kept strictly up to date, and that it must be so administered that all information desired can be found immediately. A number of engineers have come to recognize that these results cannot be uniformly and continuously obtained without adding to their staffs trained library experts, who supply a knowledge and skill which the engineer does not have along these lines, unless he has qualified by having taken a course of study in library science.

LOUISE B. KRAUSE,
Librarian, H. M. Byllesby & Co.
Chicago.

THE ALTAI RAILWAY IN WESTERN SIBERIA is now completed, according to the Russian Supplement in the London *Times* and will soon be opened to traffic. The line runs from Novonikolaievsk, on the Trans-Siberian Railway, through Barnaul to Semipalatinsk in the Steppes Provinces. It is 500 miles long and will serve the richest agricultural and mineral regions to be found in Siberia.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[Contributions to this section are solicited, and if found available will be paid for. They must be SHORT, and should be accompanied, if possible, by photographs or sketches.—EDITOR.]

Wheeled Spout Aids Concreting of Levee Slopes

CONCRETE protection for the river base of a 1600-ft. levee has recently been poured economically in alternate up-and-down strips by the light, sectional wheeled chute shown in the accompanying photographs, which delivered concrete from a mixer moved along the top of the embankment.

The dike will protect a thickly-settled section of Binghamton, N. Y., from floods on the Chenango River, which four times in recent years has inundated this part of the city. The entire levee is 2600 ft. long, the earth portion being built across the smaller, westerly channel of the river to Comming's Island. The east channel and

the Foote Manufacturing Company, which supplied the mixer, was supported on wheels which rolled on scantlings laid at intervals across the top of the forms. The slabs for this section of the work were reinforced 2 in. from the bottom with No. 41-gage woven wire mesh to minimize damage from ice jams. The 1800 cu. yd. of 1:2:4 concrete laid on the levee slope cost \$7.90 per cubic yard, according to John A. Giles, city engineer of Binghamton, who had charge of the project. Arthur L. LaRoch, engineer in charge, supervised the construction of both sections, while H. W. Fitzgerald was contractor for the embankment section described.

Another Way to Keep Centrifugal Pump from Losing Prime

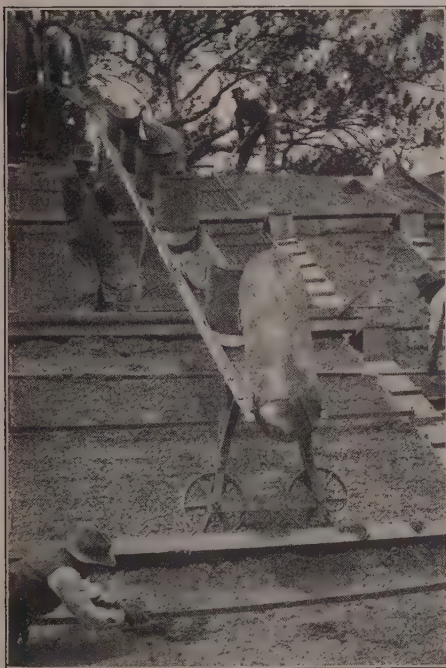
STILL another way of keeping the water in a cofferdam low with a centrifugal pump when the leakage is less than the capacity of the pump is reported by J. E. Thompson, with Larkin & Sangster, con-

pump and throttling the discharge down until it just balanced the leakage. Another advantage of this arrangement was the ease with which the pump could be primed after shutting it down to shorten the suction. This was done by opening the valve and filling the fan chamber with water previously trapped in the discharge above the valve.

Freezing of Flood Water Under Swamp Buckles Falsework

By R. C. HARDMAN
Colorado Springs, Col.

IN CONSTRUCTION work hints of what not to do are just as important as those of an opposite nature. A short time ago, during the building of a concrete structure over swampy ground, a combination of circumstances occurred which might have had serious consequences if the concrete poured had not had time to set and the falsework had not been weakened by the removal of a part of the bracing. The site of the work was a low place which



SECTIONAL CHUTE CONVENIENTLY MOUNTED ON WHEELS FOLLOWS MIXER ALONG LEVEE, PLACING CONCRETE WITHOUT NEED OF SHOVELING

part of the island was dredged out with a dragline and removed with a steam shovel and cars to provide material for the embankment. Most of the bank required a 20-ft. fill, the maximum being 35 ft. This brings the top of the levee to 26 ft. above low water and 6 ft. above the highest recorded flood. The remaining section of the dike consists of a steel-sheet-pile section 475 ft. long and a 500-ft. concrete wall.

The 6-in. reinforced-concrete slabs of the river face of the embankment were cast in alternate 10-ft. strips, using forms similar to sidewalk forms. They are carried down 4 ft. below low water mark. Although it was expected that a dry mixture would have to be used, it was found possible to hold a thoroughly wet mix on the 2-to-1 slope. The sectional chute, designed and furnished by

tractors, Seneca Falls, N. Y. Mr. Thompson's method differs from that described by William G. Broadhurst on page 611 of the Engineering Record for Nov. 13 in that the pump runs continuously at normal speed, and from the other method, described on page 802 of the Engineering Record for Dec. 25, in having only one regulating valve, and that on the discharge line just above the fan case. The 5-in. electrically-driven centrifugal pump replaced a 2-in. duplex pump, and the problem was to keep the hole dry without constantly priming the pump while the excavation progressed and the leakage increased, and then while the concrete was being placed and the flow of water gradually shut off. This was readily accomplished by putting a 5-in. gate valve in the discharge line just above the

in wet weather was filled with "cat-tails." In making excavations, about a foot under the surface a layer of sand over coarse gravel and boulders, carrying a strong underflow of water, was found. Through the site ran an irrigation and power ditch about 20 ft. wide and 3 ft. deep, which apparently had no connection with the underflow, as it was possible to lower the water in excavations with a hand pump on the very bank of the ditch and water stood at different levels though only two or three feet apart.

The work was done in the winter when the ground was frozen and the power ditch had a thick covering of ice with a consequently restricted channel. The falsework for the superstructure was built directly on the soil, although the loads were dis-

tributed so that a sudden thaw would cause no appreciable settlement. The shores were of doubled 2 x 4-in. pieces tied together transversely and longitudinally by horizontal and diagonal braces 1 x 6-in. material.

One night after the superstructure had been poured and had set sufficiently for a part of the braces to be removed, the employees of the flour mill operated by the power ditch let down a flood of water much faster than the restricted channel could carry it. The apparent result was to force some of the ditch water into the underflow. At any rate, the ground under the structure was so heaved up that the shores buckled a foot out of the vertical in a height of about 25 ft. While the movement was not large, it would have caused difficulty had the flooding and freezing taken place while the concrete was green and before the removal of the braces, which allowed lateral movement in the shores. It was at first thought that the buckling was due to some unaccountable settlement of the structure, but an instrumental check soon disproved this. By coupling the circumstance of the unusually hard freeze with the flooding of the ditch and the underflow, the assumption was arrived at that additional water had gone under the ground and had frozen, thereby causing the upheaval.

Flume Bridges Break While Large Brick Sewer Is Repaired

A STEEL-RIBBED semicircular wooden flume, assembled and sunk in place, was recently used to carry the flow of a damaged Chicago sewer and serve as invert form for repairing the break.

In building a subway underneath its tracks at Western Avenue and Bloomingdale Road the Chicago, Milwaukee & St. Paul Railway Company found it necessary to drive piles on either side of an 8-ft. brick sewer which rested in soft blue clay in order to prevent the load from a bent of column footings from coming directly on the sewer. The bottom of the footing excavation was at the center of the sewer. In driving the piles, the soil pressure raised the brick invert about 14 in. and the top part of the ring collapsed. Men were put to work immediately removing all brickwork and masonry proper, and the pile-driving work was completed as rapidly as possible. All brickwork was removed and a small portion of the lower excavation was made before an attempt was made to take care of the water and secure a dry bottom. The sewer normally ran from 2½ to 4 ft. deep, and frequently during the progress of the work light rains would cause it to run so full that at points along the line the water would rise in the man-

holes about a foot above the top of the sewer. When all the brickwork was removed and the soil excavated about to the bottom of the invert a semicircular flume was constructed of bent angle irons, lagged with 2 x 8-in. lumber, which is shown in the accompanying drawing. The ribs for this flume were placed in position above the water line and gradually lowered as lagging proceeded. When the necessary lagging had been placed the flume was lowered until the projecting ends of the lagging rested on the invert of the undisturbed sewer section at each end. The ends of the flume were made tight by calking them with burlap and clay. A 6-in. centrifugal pump had been set up on the site and within a very few minutes after the flume was sunk the hole had been pumped dry. The flume proved practically watertight. It was then a small detail to make the necessary excavation and pour concrete for the lower part of the sewer. After the concrete work had been finished it was only necessary to raise the upstream end of the flume a few inches and let the water get under it. This immediately loosened the entire flume and caused it to float at some distance above its original location, where it was easily taken apart. The top of the sewer was ordinary three-ring brick, which was placed in the usual manner. The centers supporting this work were removed and taken from the sewer at a manhole a short distance below the bridge.

Walking-Beam Traveler Reaches Over Lock Walls

A VERY handy traveler derrick for reaching over high walls without an abnormally long boom is shown in the accompanying photograph. Contractors who have built government locks and dams will appreciate the point of the walking-beam at once. It enables the traveler to rest on the lock floor and reach over the walls with an ordinary boom to handle forms and do other work. The rig shown in the photograph was one of two used in constructing the Government lock and dam on the Hudson River at Troy. It was designed by D. A. Watt, assistant engineer, and was built at the U. S. engineer yard at Troy.

The walking-beam consists of two light steel channels trussed on top and resting on the sheave pin in the outer end of the boom. From one end hangs the main fall, while the other end is tied to the pin at the heel of the boom by two 1-in. wire ropes. While the angle between the boom and the walking-beam is usually fixed it can be varied to suit conditions by adjusting these ropes. The outboard portion of the beam is 16 ft. long and the inboard portion 14 ft., the difference being made so that the beam will not tend to tip out of

position. The wooden boom is 40 ft. long, and the derrick runs on a track of 10 ft. gage. All parts are designed so that the derrick, the framing, etc., can be quickly and easily taken apart and reassembled for use on other portions of the work. The derricks are very quick in handling. If a good load has to be lifted on a low boom, as a yard bucket of concrete, a movable guy line, adjusted by block and tackle, is run to the head of the mast.

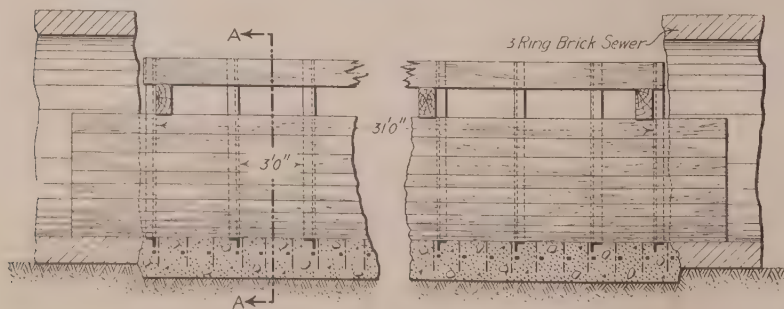


TRAVELER TO REACH OVER LOCK WALLS

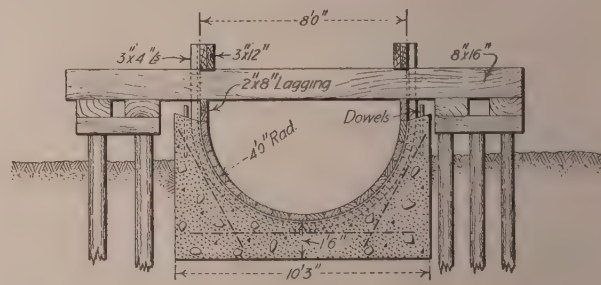
The lock and dam at Troy, the completion of which was noted on page 61 of the Engineering Record for Jan. 8, 1916, was built by Government forces under the direction of the Corps of Engineers, U. S. Army, Col. William M. Black being in general charge of the district and Maj. M. J. McDonough in charge at Troy.

Dynamite to Loosen Stuck Machine Keys

A TEASPOONFUL of dynamite, judiciously applied to the end of a stuck machine key, mud-capped and fired, has often saved Mr. Mills, a Nebraska machinist, much trouble, according to a recent letter to the editors of the *Du Pont Magazine*. The dynamite used was 40 per cent strength, and the caution is added that unless the charge is placed very accurately the flywheel or the key may be broken. Machinists who have wrestled with stuck keys in large compressor or pump flywheels, where quarters were too close for swinging a hammer, will appreciate this suggestion, though considerable skill would doubtless be required in putting it to use.



LONGITUDINAL SECTION OF FORM IN PLACE



SECTION A-A

FLUME, BUILT AND SUNK IN PLACE, WAS LOOSENEED AFTER CONCRETING INVERT BY FLOW IN SEWER AFTER RAISING ITS UPSTREAM END

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

American Society Elects Elmer L. Corthell President

Consulting Engineer of International Reputation Has Long List of Varied Works to His Credit

Elmer L. Corthell, Dr. Sc., consulting engineer, Civil War veteran, railway and bridge builder of international fame and eminent authority on harbor development, river control and shore protection, was elected president of the American Society of Civil Engineers at the annual meeting in New York this week. In his long and varied professional career in this country, Europe and South America, Dr. Corthell has given his services probably to a greater variety of large-scale engineering works than has any American engineer in consulting practice to-day.

He was born in South Abington, Mass., in 1840 and after spending two years at Brown University he enlisted as a private in the Union Army when the Civil War broke out, advancing in his four years of active service to the grade of captain. After the war he returned to Brown and received the degrees of B.A. and M.A.

From the time of his graduation until 1874 he was engaged in municipal engineering work in Providence, R. I., and railway and bridge work in Illinois and Missouri, at the end of this time being chief engineer of important levee building and construction of a bridge over the Mississippi River at Louisiana, Mo. This structure has a draw 444 ft. long, the longest in the world at that time.

Dr. Corthell's name is closely linked with the history of the control of the Mississippi River at its mouth. In 1875 he was engaged by the late James C. Eads to take charge of the engineering and construction of the jetties at the mouth of the Mississippi. On this work he was engaged for four years and when it was finished he wrote and published an illustrated "History of the Mississippi Jetties."

In 1880 he went to Mexico to make surveys for the ship railway project for crossing the Isthmus of Tehuantepec. The next four years he devoted to railroad and terminal construction in the United States, at the same time giving the benefit of his advice to the work in Mexico. From 1885 to 1887 he devoted nearly all of his attention to the ship railway project.

Entering into a partnership with George S. Morison in 1887 Dr. Corthell undertook the design and construction of railroads, bridges harbor works and waterworks. Many notable structures were built, among them being the Cairo bridge over the Ohio River for the Illinois Central Railroad, the Nebraska City bridge over the Missouri River for the Chicago, Burlington & Quincy Railway, the Sioux City bridge and others. Dr. Corthell served as chief engineer, from 1889 to 1890, of the St. Louis Merchants bridge over the Mississippi River and chief engineer of the improvements at the mouth of the Brazos River at Texas, consisting of jetties in the Gulf of Mexico. For the next three years he acted as consulting engineer of important railway construction in Chicago. He was in charge of extensive improvements at the harbor of Tampico, Mexico, and then went to Europe where he made a long tour of inspection of engineering projects of all kinds.

The Mexican Government retained him in 1882 to complete the important inter-oceanic route across the Mexican Isthmus. By this time he had achieved such professional dis-

(Continued to page 129, second column)

Unusually Spirited Discussion Characterizes Annual Meeting of American Society

Prof. C. R. Mann Raises Important Question, "What Is an Engineer?"
—Meeting Votes in Favor of Military-Preparedness Resolutions

WHAT is an engineer? This question was raised by Prof. C. R. Mann of the Carnegie Foundation at the sixty-third annual meeting, Jan. 19, of the American Society of Civil Engineers, in a short talk explaining the work of the Foundation in the study of engineering education. Summarized replies from 1500 engineers to questions sent out last spring by the Foundation indicate that technical ability is worth but 13 per cent in a total of 100 per cent—non-technical attributes, such as character and executive ability, constituting the remaining 87 per cent. Before the Foundation accepts this ratio, however, another set of questions bearing directly on the matter will be sent out, and to a larger number of engineers. Military preparedness was brought into con-

sideration by a set of resolutions offered by R. S. Buck. The spirit of the resolutions was accepted by the meeting, but their ponderousness was criticised, and the board of direction was instructed to edit them that afternoon for presentation at the congress of the American Security League in Washington the next day. Debate over whether or not the committee on materials for road construction was doing satisfactory work or could do it without enlargement or change of personnel ended in a vote to request the board of direction to consider the advisability of enlarging the committee and its scope. A plea for closer co-ordination of the national society with local societies on the one hand and engineers of other countries on the other was voiced by the incoming president, Dr. Corthell.

As is customary, the meeting was held at the society house in New York. An hour after its adjournment 712 registration cards had been given out, slightly less than last year.

Directors' Report

The annual report of the board of direction for 1915 showed a gain in membership of only 231, as compared with 406 for the previous year. The decrease is attributed mainly to general financial conditions. The total membership Jan. 1, 1916, was 7909.

The library now contains 25,872 bound volumes, 48,452 unbound volumes, 7859 specifications and 5236 maps, photographs and drawings—a total of 87,429 and a gain of 3965.

Twenty-three meetings, which about 5022 attended, were held during the year. Twenty-one formal papers and four lectures were presented. Five papers were also published but not discussed at any meeting. The number of members and others who took part in the preparation or discussion of these papers and lectures was 252.

During the year \$10,000 was paid on the mortgage of the society, reducing the debt to \$50,000. Increased expenditures for the work of the special committees, and for mileage to members of the board of direction and the nominating committee, due to a larger attendance, prevented any increase in the reserve fund, which remains at \$90,000. Payment of the mortgage debt in full may be made soon, leaving \$40,000 in the reserve fund.

Road Construction and Materials

The first special committee to report was that on materials for road construction. E. W. Stern expressed the view that the committee had not produced authoritative recommendations such as the society might reasonably expect, and moved that the board be requested to enlarge the committee. The chairman defended the committee's work, and considerable debate followed, which terminated in a compromise motion, which was adopted, that the board be requested, as stated in the first para-

New President of the American Society of Civil Engineers



DR. ELMER L. CORTHELL

Circuit Court Upholds Indiana Fire Marshal Law

The State Fire Marshal law of Indiana has been declared constitutional by the Circuit Court in a decision rendered by Judge Denney in the case of the Red Cross Lodge No. 88, Knights of Pythias, vs. W. E. Longley, State Fire Marshal, et al. The Lodge sought to enjoin the Fire Marshal from tearing down a livery stable in Portland, Ind., which the latter had ordered removed on June 18, 1913, for the reason that it constituted a fire menace.

After appeal by the Lodge to the Circuit Court, a change of venue and final appeal for an injunction, the trial on Dec. 24, 1915, was limited to the question of the constitutionality of the law on which the Fire Marshal's order was based. After holding the matter under advisement for some time, Judge Denney rendered judgment for the Fire Marshal and refused to grant the injunction.

graph, to consider the desirability of enlarging both the committee and its scope.

Speaking for the committee on a national water law in the absence of the chairman, Gardner S. Williams read part of the progress report printed in the December *Proceedings* of the society. The conclusion reached by the committee is that the uses of water are so diversified and important that a national water law is inadvisable until engineers have discussed the vital principles.

What Is an Engineer?

In connection with the report by Desmond Fitzgerald, chairman of the committee on engineering education, Prof. C. R. Mann of the Carnegie Foundation, which the society's committee is assisting in the investigation, made a short talk which aroused the interest of all. He pointed out that the fundamental problems were what constitute the essentials of a successful engineer, and how they are measured. Last spring, in response to questions on these points sent out to practising engineers, 1500 replies were received. These were carefully studied, and from them were compiled the following composite opinion of the relative values of attributes:

- | | |
|---|------------|
| 1. Character, including integrity, responsibility, resourcefulness, initiative..... | 41.0 |
| 2. Judgment, including common sense, scientific attitude, perspective..... | 17.5 |
| 3. Efficiency, including thoroughness, accuracy, industry..... | 14.5 |
| 4. Understanding of men, executive ability..... | 14.0 |
| 5. Knowledge of the fundamentals of engineering science..... | 7.0 |
| 6. Technique of practice and of business..... | 6.0 |
| | <hr/> 87.0 |
| | <hr/> 13.0 |

Professor Mann pointed out that if technical ability is worth only 13 per cent, technical education should evidently be radically changed. Before accepting this rating, however, another set of questions will be sent out, the answers to which will, he hopes, confirm or refute the figures. He holds that if the engineer will define the finished product desired from the technical school the school man will turn it out.

Other Committees

The committee on stresses in track reported that the various apparatus for measuring the stresses had only recently been brought to a satisfactory state, but that tests had already been instituted on a section of the Illinois Central Railroad near Champaign, Ill. The committee on flood prevention offered its report as final, and a motion was made to accept it and discharge the committee. Morris Knowles, author of the minority report, urged that the committee be continued, however, and his motion was carried. The committee on concrete and reinforced concrete announced that a final report would be submitted before July. Progress was reported by the committees on valuation and the bearing value of soils. No report was made by the committee on steel struts and columns, as its progress was reported in the December *Proceedings*, and none was made by the committee on compensation of engineers.

Military Preparedness

R. W. Buck introduced a long set of resolutions favoring military preparedness, for ratification in time to be presented at the congress of the American Security League in Washington the next day. The spirit of these resolutions was evidently generally approved, but their length and form was not. After considerable discussion it was voted that the board of direction be instructed to edit them that afternoon so they could be used for the purpose intended.

The incoming president, Dr. E. L. Corthell, mentioned various tasks that he readily perceived were confronting him. Briefly they involved the nationalization of all engineers, the revision of the society's constitution, the encouraging of local engineering societies, the furthering of military preparedness, co-opera-

tion with Pan-American activities and the internationalization of engineers.

Prizes and Officers

Prizes were awarded during the year as follows: Norman Medal, to Allen Hazen, for his paper on storage to be provided in impounding reservoirs; J. James R. Croes Medal, to R. R. Lyman, for the paper on improved forms of weirs; Thomas Fitch Rowland Prize, to C. R. Staniford, for that on pier construction in New York harbor; James Laurie Prize, to J. E. Greiner, for that on coal piers on the Atlantic seaboard; Collingwood Prize for juniors, George Schobinger, for that on the Colorado River siphon.

Officers for the coming year were elected as follows: President, Dr. E. L. Corthell; vice-presidents, Alfred Craven and P. C. Ricketts; treasurer, Lincoln Bush; directors—district 1, V. G. Bogue and Dr. A. C. Humphreys; district 2, O. F. Clapp; district 4, Richard Khuen; district 5, F. G. Jonah; district 7, Edwin Dur-yea, Jr.; members of nominating committee—district 1, E. J. Fort; district 2, S. E. Tinkham; district 3, F. W. Cappelen; district 4, H. H. Quimby; district 5, E. N. Layfield; district 6, W. B. Gregory; district 7, J. B. C. Lockwood.

The next annual convention will be held Jan. 27-30 at Pittsburgh.

Agreement Reached as to New York's West Side Improvement

Agreement has been reached between the city of New York and the New York Central Railroad relative to the removal of its West-Side freight tracks from grade in Eleventh and Tenth Avenues. The project, which involves the entire freight line of the New York Central from the junction with the main line at Spuyten Duyvil, at the upper end of Manhattan, to St. John's Park, the terminal in lower Manhattan, has been under discussion for many years. The details are yet to be worked out, but the salient features are as follows:

An elevated structure on private right-of-way east of West Street, from St. John's Park to Thirtieth Street.

An elevated structure from Twelfth Avenue and the marginal way from Thirtieth Street to Fifty-ninth Street.

Covered tracks under Riverside Park, and from 135th to 153rd Street.

Covered tracks on the present right-of-way through Fort Washington Park.

A viaduct over Dyckman Street.

A tunnel under Inwood Hill.

The cost of the improvement is estimated at \$50,000,000. It is expected that the legal approval will be concluded in about two months, after which construction will proceed.

For the city the engineering studies have been handled by a board of engineers in the employ of the city, who served as consulting engineers to the committee on port and terminals of the Board of Estimate and Apportionment. These engineers are Ernest P. Goodrich, consulting engineer to the borough president of Manhattan; C. W. Staniford, chief engineer of the Department of Docks and Ferries, and John F. Sullivan, engineer of the Bureau of Contract Supervision of the board. For the railroad G. A. Harwood, chief engineer of electric zone improvements, and H. D. Jewett, designing engineer of West-Side improvements, handled the engineering end of the negotiations.

Report as to Licensing of Engineers in Pennsylvania Unverified

In the issue of the Engineering Record of Jan. 1 it was stated that the committee appointed to investigate the advisability of licensing engineers in Pennsylvania would probably report favorably to licensing.

Inquiry made by this journal fails to substantiate the report. The committee has not yet declared what its attitude will be.

Pan-American Congress Urges International Triangulation

Among other matters recommended in the resolutions of the Pan-American Scientific Congress, adopted at the final session in Washington, are several recommendations of engineering interest. Among them are that committees be appointed for the purpose of establishing an international triangulation, that a Pan-American committee be established to study and report upon the question of establishing a uniform railway gage, that the administrative practice of regulating the use of water be studied, that its use upon arid and irrigable land be investigated, and that the question of the reclamation of arid land is one that should receive the immediate and careful consideration of the several governments of the American states. It is suggested that the proper steps and measures be taken to bring about in the American Republics participating in the Congress a general use of the metric system and weights and measures.

Accurate geodetic measurements which may serve to contribute to the discovery of the true shape of our planets should be taken as soon as possible according to the resolutions adopted. It is proposed that the nations of the American continent establish by means of their offices of geodesy, or by committees appointed for that purpose, an international triangulation, and that the governments of American nations reach an agreement for the purpose of creating an office, or congress, of cartography and geography. The adoption of the metric system in this hemisphere is recommended, and, it was resolved, proper steps and measures should be taken to bring it about as soon as possible. The appointment of a Pan-American committee to study and report upon the questions of establishing such a uniform railway gage as will best serve the countries interested, their international communication and communication between all countries of America is suggested. It is also recommended that each of the American nations appoint a commission to investigate and study in their respective countries the existing laws and regulations effecting the administrative practice of regulating the use of water, the adjudicating of rights pertaining to the use of surface and underground water for irrigation purposes, the distribution, application and use of water upon arid and irrigable land, the method of conservation of surface and underground water for irrigation or industrial purposes, and to suggest laws or regulations in the interests of general industry, navigation and commerce.

General Dodge Leaves \$300,000 to Norwich University

Norwich University, where the late Gen. Grenville M. Dodge received his professional education, was a beneficiary in his will, which was filed at Council Bluffs, Iowa, Jan. 10, to the extent of \$300,000. Of this sum, \$50,000 is immediately available for paying the salaries of professors of civil, military, electrical and mining engineers. The \$250,000 remaining will be paid after a trust fund for the immediate family is dissolved in future years.

Consulting Engineers Selected for Barge Canal Improvements

Dr. Elmer L. Corthell, consulting engineer, of New York City; Henry C. Allen, consulting engineer, of Syracuse, N. Y.; Eugene E. Haskell, director of the College of Civil Engineering, Cornell University; Joseph Ripley of the board of consulting engineers of New York State canals, and E. C. Moore, formerly consulting engineer for the New York City Board of Estimate and Apportionment, have been selected as members of the board of consulting engineers on the improvements to be made on the New York State Barge Canal under the recently voted \$27,000,000 bond issue.

Seattle Water Main Collapse Preceded by Undermining

Covering Over Pipe Consisted Largely of Heavy Boulders—New Staves Cached at Convenient Points Facilitated Repairs

A force of 100 men worked for three days and three nights to clear the excavation preparatory to repairing the break in the wood-stave supply main, at Seattle, which was described on page 93 of last week's issue of this journal. New staves cached at convenient points along the line facilitated the work. At the point where the break occurred the escaping water washed away the support of the pipe, leaving a chasm into which the main settled and collapsed for a distance of about 100 ft.

Total Length of Mains, 66.61 Miles

The total length of the two large supply mains from the headworks on Cedar River, 28 miles from the city, is 62.61 miles, line 1 being 28.57 miles in length and line 2 being 34.04 miles, chiefly wood. The least diameter of the pipe in line 1 is 42 in., the greatest diameter 44½ in. The least diameter of line

sure required the use of heavy steel pipe. At this point there has been no trouble, except occasional areas of pitting in the pipe due to the action of electrolysis.

At the place where the pipe broke the back-filling and covering consisted very largely of heavy boulders, which did not form a compact arch over the pipe and left the whole superincumbent weight resting upon the pipe. When the break occurred the escaping water washed away the support of the pipe, leaving a chasm into which the pipe settled and collapsed, for a distance of about 100 ft. At the point of collapse the sides of the cut were very high, and much of the material that had to be removed in uncovering the pipe had to be carried by hand some 30 or 40 yards lengthwise through the excavation. As some of these boulders were from 20 in. to 30 in. in diameter, the difficulty of uncovering it is apparent. It required the labor of about 100 men for three days and three nights to clear the excavation of rock and broken staves.

Cached Staves Facilitate Work

New staves are cached at convenient points along the line so that there was no delay in getting the necessary material to rebuild the section destroyed. After the water was turned



MAIN PIPE LINE REPAIRED AFTER BREAK—NEW STAVES CACHED AT NUMEROUS POINTS EXPEDITE WORK

2 is 48 in. and the greatest 60 in. Both pipes pass over rough country. The static head varies from 10 or 12 ft. at the intake to about 530 ft. at the crossing of the Black River near Renton, the hydraulic head rising at that point to 485 ft. For the first 15 miles the hydraulic head is low, varying from a few feet to about 65 ft., except at one or two points where it rises to about 160 ft.

There has been but little trouble with the line between Renton and Seattle, where the hydraulic head is sufficient to keep the staves thoroughly saturated, but, on the upper 15 miles, where the pressure is low and where the soil, for the most part, is gravelly, the staves, it is said, have shown evidence of decay. Leaks and breaks of more or less magnitude developed, from time to time, after the pipe had been in use six or seven years, and in a few cases small sections of main have collapsed.

Hydraulic Head Low Where Break Occurred

The break occurred where the hydraulic head is very low, the pressure at that point being only 10 or 12 lb. The soil is very gravelly and porous, permitting free entrance of the air through the covering, and there are considerable variations of temperature.

Across Black River Valley the high pres-

sure on a new trouble developed about 9 miles from the intake, at a point where the pressure was low, which required two days and two nights to remedy. With the exception of the 24 hr. constituting the interval between the repairing of the first break, and the discovery of the second, the water was off about seven days.

The storage capacity in the city is 270,000,000 gal. About 200,000,000 gal. of this had been exhausted while water was off, leaving about 70,000,000 storage when the water was turned on the second time.

It is possible that much of the upper end of the line may have to be rebuilt within a year or two.

Highway Construction in Alaska to Be Requested of Congress

An appropriation to improve the highway from Fairbanks to the coast is to be asked of Congress by the people of Alaska, according to a recent report from the northwest. It is desired to make this road suitable for motor travel, which is estimated to require an expenditure of about \$1,000 per mile, or \$358,000. If these improvements were made it is thought that the traveling time between these two points could be reduced two or three days.

Lake Erie & Ohio River Canal Board Retains Engineers

At a recent conference of the Lake Erie & Ohio River Canal Board, it was decided to retain Isham Randolph, consulting engineer, of Chicago, to examine and check up the engineering and other data now in the possession of the board and to give his opinion on the canal project. George F. Stickney, consulting engineer, of Albany, N. Y., who prepared the estimates for the first canal board, was also engaged to assist the present board in certain engineering matters engaging its attention. George M. Lehman, chief engineer of the canal board, who was present at the conference, and who conducted surveys and estimates upon several previous occasions for the project, will act with the above named engineers in completing the report which it is intended to have in form by early spring.

Plan to Dredge New Inner Harbor Channel at Victoria, B. C.

Plans for a channel that will afford an entirely new passage into the inner harbor at Victoria, B. C., were discussed at the ninth annual meeting of the Victoria Inner Harbor Association, held in that city on Jan. 11. A. F. Mitchell, acting district engineer of the Dominion government, outlined plans which the government proposes to follow during the present year in opening up a new channel with a width of 300 ft. and a low water depth of 20 ft. by improving what is known as the Northwest passage. Borings have been made, it is reported, which show that in dredging for the new channel no rock would be encountered. This condition is expected to greatly reduce the cost of the work, as well as to expedite the construction.

Commissioner Hodge's Debut

The Public Service Commission's hearing upon the application of a taxpayers' association for an order directing increase of accommodations by a corporation without increase of fare gave a taste of Commissioner Hodge's quality. The usual argument of the convenience of a great many citizens was made, and Commissioner Hodge remarked:

"It isn't a question of how many people would like to have the transfers, but it's a question of whether it is reasonable to impose the order upon the company."

Whereupon Chairman Straus asked:

"You would not ask us to do anything that would make any less the income of a company which is already suffering a loss?"

The similarity of these views is no less striking than their similarity to those of Justice Hughes. That public service which wears best is the most truly popular, and there can be no manner of doubt that the regulation of public utilities in the Hughes manner is the most popular sort. Those who tried a different sort of regulation have been retired, while Justice Hughes is driving from his doors those who want to draft him for other duty.—*New York Times*.

Commission Engineer Declares Public Ownership Inefficient

That the poorest managed utilities in Indiana at the present time are those municipally owned was the declaration of H. O. Garman, chief engineer of the Public Service Commission of Indiana, in a recent address before the Saturday Lunch Club of Indianapolis. Partisan politics he blames for this. The complete changes in management of municipal plants now made with each change of administration work to the entire disadvantage of the enterprise. The municipal plant which furnishes a rendezvous for political workers cannot succeed, he said. No such shiftless management is tolerated in the privately owned plant, which is operated to show a return on the investment.

Institute of Consulting Engineers Holds Annual Meeting

President in Annual Address Points Out Opportunities for Public Service—Institute Urged to Join International Federation

The opportunity of the engineer to render public service was the keynote of the presidential address of Dr. E. L. Corthell at the annual meeting of the American Institute of Consulting Engineers at the Engineers' Club, New York, Jan. 17. He cited the instances during the year in which the institute as a body had undertaken work for the general good, and also indicated directions in which further work was possible. He emphasized the desirability of co-operation between the institute and the Chamber of Commerce of the United States of America, of which the institute is a member. The chamber is about to take up inland waterways and the merchant marine, in which there should be a large engineering interest, and in which the advice of the institute would be of material assistance to the chamber. Dr. Corthell urged, too, that the membership of the institute, now numbering eighty, be enlarged by the addition of those with a professional record and experience commensurate with the institute's requirements.

Valuation

Following the reading of committee reports there was a discussion on valuation, participated in by Gustav Lindenthal, Gardner S. Williams, Dr. A. C. Humphreys and F. A. Molitor. As a result of this discussion it was resolved that the council of the institute be asked to take under consideration the advisability of appointing a standing committee of the matter of valuation. It was pointed out that in this subject, now of exceedingly great interest and importance, because of the government's valuation of railroads, the institute might bear an important part in shaping the views of the public along sane lines.

A touching incident of the evening was a brief tribute to the memory of C. C. Schneider, by Mr. Lindenthal, and a brief suspense of the proceedings while the members stood silent as a mark of respect for the deceased member.

Reporting on the matter of the institute's part in the preparedness movement, Ralph Mershon told of the bill for an officers' reserve corps, which had been made part of the Administration's preparedness program. Mr. Mershon also called attention to a bill introduced in the Senate by Senator Pomerene of Ohio which makes possible, through additional instructional officers detailed from the army, the improvement of the courses of military instructions in the Land Grant Colleges. The meeting approved of Mr. Mershon's proposal to give the support of the institute to this measure.

International Federation

There was present as a guest of the president, Dr. Corthell, R. E. Mathot, president of the Chamber of Consulting Engineers of Belgium and chairman of the council of International Federation of Consulting Engineers. Mr. Mathot recounted briefly the progress of the international federation, pointing out that at the Ghent Convention, which was the first, there were eleven associations represented. In 1914, at the Berne Convention, there were fourteen associations, the new ones being the Swiss, Polish and Austrian societies. He stated that an association now in process of formation in Italy would come into the federation, and that only England and the United States would then be unrepresented in the international body. He urged strongly that the American institute come in, pointing out the advantages in standardizing codes of ethics and in making possible the recommendation by engineers in one country of thoroughly competent men in others. Among the pro-

posed activities of the international federation is the publication of a year book, giving fully the qualifications of the members, so that their selection for work by their fellows in foreign countries will be made easy.

The election of the following members of the council was announced: S. Whinery, A. C. Humphreys, G. F. Swain, F. A. Molitor.

Rain Storms and Floods Isolate Southern California Towns

As we go to press a terrific rain storm is raging in Southern California, and although flood damage to railways, highways, bridges and public utility properties generally has been heavy, no final estimate can yet be made. Press reports place the damage thus far at about \$2,000,000. At least six lives were lost. Up to midnight of Jan. 18, the rainfall for the storm was 5.79 in. in Los Angeles, with the downpour still continuing. Extreme flood conditions were due to a warm rain on deep Sierra snows, causing almost every stream in the Los Angeles district to overflow. The rainfall was unusually heavy in the mountains. At Upland it was 10.85 in.

Los Angeles was completely isolated on Jan. 19 by the impassable conditions of all highways and railways to the east, north and south. About fifteen through trains were stormbound in the mountains. Street car service was maintained on certain lines only, and many downtown streets were flooded.

Dynamite was used to clear debris jams in the Arroyo Seco, which threatened to cause overflows into adjacent sections. It is reported that the \$30,000 bridge over the Santa Ana River has collapsed and that the Tippecanoe Avenue bridge is also a total loss. Near Bell Station the Los Angeles River was three miles wide with housetops showing in midstream. The Pomona region suffered heavily because a temporary stoppage of the San Gabriel River gave way suddenly, releasing a wall of water which caused excessive damage in the valley and endangered Pomona College buildings.

In the oil fields near Bakersfield several hundred oil derricks were blown over, and damage estimated to total several hundred thousand dollars is reported. Water was flowing over the spillways of the Sweetwater and Roosevelt dams, and workmen were attempting to avert a threatened break in the Salt River Levee near Phoenix.

Carnegie Steel Co. to Build \$7,000,000 Plant at Youngstown

Announcement is made by Homer Williams, president of the Carnegie Steel Company (a subsidiary of the U. S. Steel Corporation), that construction of the new plant at Youngstown, so long contemplated, will be commenced at once. The plant will be located on a 500-acre site between Girard and Niles near Youngstown and will be known as the McDonald Mills, named for Thomas McDonald, who has been general superintendent of the Ohio Works for twenty-two years. At present ten merchant bar mills, of the total thirty contemplated in the future, will be built and will employ between 1500 and 3000 men. The annual capacity is estimated between 400,000 and 500,000 tons. Over 200 by-product coke ovens and an electric power plant will be built, the total amount appropriated being \$7,000,000. Railroad connections to all the trunk lines in the Youngstown district will be made through the Youngstown & Northern, which passes through the site.

New York Assembly Passes Canal Bill

The New York State Assembly passed, Jan. 18, a bill making available for the completion of the Barge Canal the \$27,000,000 provided in the bond issue referendum last November. A similar bill has been introduced in the Senate.

Enforcing the Red Flag on New York Subway Work

Flags Placed in Trolley Slots and Ropes Stretched Across Street Before Blasting—Caution Signs on Decked Streets

How to enforce traffic regulations in New York City over subway decking where blasting is being done has been a pressing problem with the Public Service Commission and the subway contractors since the violation of these regulations caused the loss of several lives in the Seventh Avenue collapse on Sept. 22, 1915. It was pointed out by the Engineering Record at that time, and subsequently, that little could be done without the help of the police. This help has been secured, to a considerable extent, and it is thought that, while individual carelessness is still a menace both to the public and the workmen, conditions are improved.

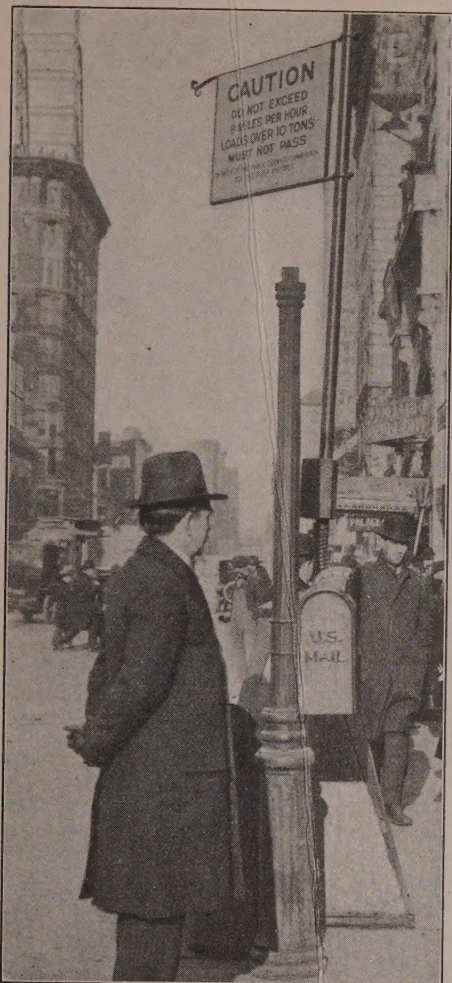
Two types of signs, put up and enforced with the help of the city authorities, are shown in the accompanying photographs. While from a safety standpoint it might be thought preferable to make these signs larger and fix them securely in the roadway itself at the end of decked streets, it was believed that the object of the signs could be attained without placing them so as to restrict traffic physically.

At the suggestion of the fire department, the Public Service Commission has instructed contractors to place red flags on sticks in the trolley slots to stop the cars when a blaze is to be fired. The plan is now working well, although it is said that the first motorman on whom it was tried leaned out of his vestibule, threw the red flag into the gutter and went by so fast that the contractor's men failed to get his number.

The two sections of the Broadway-Seventh Avenue line on which the accompanying photo-



SIGNS MARK DECKED BLOCKS SUPPORTED ON FALSEWORK



SIGN ON CORNER POST WARNS TRAFFIC ON BOTH STREETS

graphs were taken are being built by the Litchfield Construction Company and the Holbrook, Cabot & Rollins Corporation. Both these contractors now stretch two ropes decorated with red flags entirely across the street and clear the space between them before firing a blast. Workmen engaged in stretching these ropes are said to have been run into, deliberately or otherwise, in a number of instances by cars or vehicles in a hurry to get by before the blast was fired. On the work of the first-mentioned contractor an automobilist ran through one line at full speed after it had been stretched. Fortunately a large number of the contractor's men were on the street at the time, having just come up for lunch. They surrounded the car and brought it to a stop. The police arrested the driver, and he was promptly fined on being brought into court. It is instructive to note that this man was fined for disorderly conduct. Running over a danger signal is not a legal offence in New York City.

Incidents of this kind show the difficulties with which the commission and contractors have to contend, as well as the sincere efforts now being made by the city authorities to protect both the public and the subway construction. They also suggest that one blue uniform is more potent than forty red flags when it comes to convincing traffic that a blast zone is an area to be respected.

U. S. Chamber of Commerce to Meet Early in February

The Chamber of Commerce of the United States of America will hold its fourth annual meeting in Washington, D. C., Feb. 8, 9 and 10. The greater part of the program will be taken up with foreign trade questions and with domestic questions which have been brought to the front by the foreign situation.

American Society Elects Elmer L. Corthell President

(Continued from page 125, first column)

tion that Brown University, in 1884, conferred upon him the degree of Doctor of Science.

Dr. Corthell undertook another extensive European tour in 1897, this time devoting most of his attention to river and harbor work and the protection of sandy coasts against encroachments of the sea. For eleven years he served as consulting engineer on the Cape Cod Canal in Massachusetts, and was retained by the Argentine Government to act as its consulting engineer for two years on important problems connected with the great harbors of that country. In 1904 the Governor of New York State appointed Mr. Corthell upon the advisory board of consulting engineers to build the State Barge Canal from which position he resigned in order to give all of his time to Brazilian work.

Mr. Corthell is at present in consulting practice in New York City and is a member of numerous engineering and scientific societies in this country and abroad. He is also president of the American Institute of Consulting Engineers and has always taken an important part in international engineering congresses. He has been a prolific writer and has made important contributions to the technical press and the proceedings of engineering societies.

San Fernando Irrigation Project Under Way

The San Fernando irrigation project, which contemplates supplying Los Angeles aqueduct water to irrigable lands in the San Fernando Valley, is on a construction basis as a result of a meeting in San Fernando Dec. 27. At this time the legal firm employed by the city reported favorably upon the validity of the \$2,650,000 bond issue of Los Angeles Water Works district No. 3.

At this meeting William Mulholland urged immediate action in order that part of the system at least could be built in time to supply water during the coming summer. The city, he said, may possibly sell at least \$100,000 during 1916.

The work of constructing the pressure distribution system will be done under the supervision of William Mulholland, who has been appointed chief engineer of the district to serve without pay.

Railway Engineering Body Announces Nominees for Office

A. S. Baldwin, chief engineer of the Illinois Central Railroad, has been announced as the nominee for president of the American Railway Engineering Association for the coming year. C. A. Morse, chief engineer of the Rock Island lines, is nominated for vice-president. For treasurer and secretary the present incumbents, Geo. H. Bremner and E. H. Fritch, are renominated.

Three directors are to be chosen from the following nine nominees: R. N. Begien, Baltimore & Ohio Southwestern; W. M. Dawley, Erie; L. A. Downs, Illinois Central; John V. Hanna, Kansas City Terminal; A. J. Himes, New York, Chicago & St. Louis; C. E. Lindsay, New York Central; W. D. Pence, Engineering Board, Interstate Commerce Commission; F. E. Turneure, University of Wisconsin, and J. E. Willoughby, Atlantic Coast Line.

Five members of the nominating committee are to be selected from these ten candidates: A. M. Burt, Northern Pacific; A. F. Dorley, Missouri Pacific; W. K. Hatt, Purdue University; V. K. Hendricks, St. Louis & San Francisco; M. A. Long, Baltimore & Ohio; A. Montzheimer, Elgin, Joliet & Eastern; A. R. Raymer, Pittsburgh & Lake Erie; O. E. Selby, Cleveland, Cincinnati, Chicago & St. Louis; A. F. Robinson, Atchison, Topeka & Santa Fé, and E. B. Temple, Pennsylvania.

President Asks Help of Engineers for National Defense

Five Societies Represented on Naval Consulting Board to Aid in Organizing Industries for Efficient Use in War

The plan of President Wilson, announced Jan. 16 by Secretary Daniels, will enlist the engineers of the country through the five national societies represented on the Naval Consulting Board for the purpose of organizing by states all the industrial plants of the country whose output would be of use to the nation in the event of war. A representative is to be appointed by each society for every state, and these five men are to list all industrial plants producing food, clothing, construction material, steel products and everything else that is classed as munitions in time of war. These lists will make the navy and war departments familiar with the resources at the disposal of the country. These departments will then scatter small orders from time to time among all the plants listed, so that each one will have government plans and specifications for its products always on hand and will also have a force that is experienced in producing government supplies.

Loss of Big Plants Would Not Stop Supplies

The plan would develop the small plant, and enlist manufacturers widely distributed over the country, so that the crippling of a few plants or the loss of a manufacturing section of the country would not curtail our supplies of important materials. Advice will also be given in selecting new equipment and making extensions, so that after a time each plant will be able to turn its entire capacity to government service on short notice in emergency. The active help of the 36,000 membership of the five societies is to be enlisted to develop the plan. The state of New Jersey has already been tentatively surveyed in this way by a committee of the Naval Consulting Board, disclosing 800 factories which could make war supplies in emergency. The membership of the five societies in New Jersey is 1200, or three men to every two plants.

Letter Announcing Plan

The first intimation of the proposed scheme was given to the public in a letter from President Wilson to W. L. Saunders, president of the American Institute of Mining Engineers, which was dated Jan. 13, and read as follows:

"The work which the American Institute of Mining Engineers has done through its members on the Naval Consulting Board is a patriotic service which is deeply appreciated.

"It has been so valuable that I am tempted to ask that you request the Institute to enlarge its usefulness to the government still further.

"This can be done by nominating for the approval of the Secretary of the Navy a representative from its membership for each state in the Union to act in conjunction with representatives from the following: American Society of Mechanical Engineers, the American Society of Civil Engineers, the American Institute of Electrical Engineers, and the American Chemical Society.

"The purpose is to assist the Naval Consulting Board in the work of collecting data for use in organizing the manufacturing resources of the country for the public service in case of emergency. I am sure that I may count upon your cordial co-operation."

Numerous Papers for Joint Meeting of Illinois Societies

Forty-four papers and reports are scheduled on the advance notice of the joint meetings of the Illinois Society of Engineers and Surveyors Jan. 26, 27 and 28, and the Illinois section of the American Waterworks Association Jan. 25,

26 and 27. The subjects are: Sewers and sewage, four papers; garbage, one; waterworks and related subjects on purification and supply, twelve; drainage and irrigation, seven; paving and roads, thirteen; surveys, five; concrete, one; general, two. Among those who have promised papers are Paul Hansen, E. S. Hanson, Edward Bartow, W. R. Gelston, F. C. Amsbary, C. B. Williams, C. A. Jennings, C. R. Knowles, C. G. Elliott, Benjamin Brooks, L. Kirschbaum, H. J. Fixmer, H. E. Bilger, B. H. Piepmeier, E. F. Motsinger, H. B. Bushnell, Duff A. Abrams, H. E. Babbitt and F. H. Newell.

Prof. Ira O. Baker is the chairman of local arrangements. Accommodations have been provided at the engineering hall of the University for exhibitors. E. E. R. Tratman, Wheaton, is secretary of the engineers society, and Edward Bartow, Urbana, is secretary of the waterworks section.

Steam Plants Replaced by Water Power in Drum Project

Two new power plants, now under construction by the Pacific Gas & Electric Company, will deliver 25,000 kw. additional load to the San Francisco territory, replacing the steam plants in Sacramento and Oakland, and making them available as reserve supplies of the system. The plants, known as plants 4 and 5, are situated near Auburn, and are supplied with water from a 22-mile canal which was built two years ago to convey water from Bear River to the irrigation district near that city.

The canal terminates near plant 4, a few miles above Auburn, and water is conveyed from the canal to the plant through a riveted steel pipe, varying from 8 ft. to 6 ft. in diameter, which delivers the water under a head of 342 ft. From the tailrace of plant 4 the water enters a 5½-mile canal leading to the forebay of plant 5, whence a steel pipe line, 6000 ft. long, conveys it to the power house, delivery being made under a head of 520 ft. From the tailrace of plant 5 the water is delivered into the irrigation system which the company maintains. There is a possibility of this water being still further used in a plant lower down which would be known as plant 6, provided that the irrigation requirements in later years warrant such development.

In providing the additional transmission-line capacity to convey energy from the new stations, a north and south line will be constructed which will tie into the Electra line just east of Stockton, from which point the existing lines would be used in connection with a short cut across the lower end of the bay at the Dumbarton bridge.

The additional 25,000 kw. which the new plant will deliver will be absorbed partly in San Francisco and partly in outlying cities. The energy which is now generated by steam in the Sacramento and Oakland substations will be replaced by energy from the new plants when these are in service. Thus the two new plants will take the load of the auxiliary steam stations, will increase the reserve supply of the system, and will materially increase its flexibility and dependability by virtue of the new route to San Francisco, as well as its connection, via the Drum line, with the main transmission arteries.

The steel work for the power house at plant 4 was erected and the crews were ready to begin pouring concrete Jan. 1. The plant will be equipped with two 9000-hp. Allis-Chalmers turbines, which will drive a single 12,500-kw., 6600-volt Westinghouse generator. Plant 5 will be equipped with the 20,000-hp. Pelton-Doble waterwheel of the Francis type that was on exhibition in Machinery Palace at the Panama-Pacific International Exposition. It will have the same type of generating unit as plant 4.

A tower line will be run north from plant 4 to connect with the transmission line from

Drum power house, while from plant 5 a transmission line will run south for a distance of about 63 miles and connect with the line from Electra just east of Stockton. The line construction will be practically the same as on the line from the Drum power house, having 70-ft. towers spaced 800 ft. apart.

At the present time the route of the transmission line from plant 4 north is being brushed out and the tower footings will probably be placed in the early spring. The towers for the entire length of the transmission line will have concrete footings. Most of the property rights on the line from plant 5 south have been acquired, but active construction on this section of the work will not be started until summer. It is estimated that the two plants will be put in service about November, 1916.

News of Engineering Societies

The Canadian Railway Club will hold its annual dinner at the Windsor Hotel, Montreal, Jan. 29.

The Idaho Society of Engineers will hold its annual meeting at Burley, Feb. 21-23. Ira F. Shaffner of Boise is secretary.

The Albany Society of Civil Engineers will hold its annual meeting and banquet at Keeler's Maiden Lane Hotel, Albany, Jan. 25, at 8.30 p. m.

The Minnesota Surveyors and Engineers' Society will hold its annual meeting in St. Paul, Feb. 10, 11 and 12. George H. Herrold, of St. Paul, is secretary.

The Manitoba Branch of the Canadian Society of Civil Engineers will hear E. Brydone-Jack speak on "Movable Bridges" at a meeting to be held at Winnipeg, Feb. 3.

The Engineers' Club of Baltimore will hear Col. John Biddle, Corps of Engineers, U. S. A., speak on "The Duties of Engineers in Warfare" at a meeting to be held in that city, Feb. 3.

The American Association of Engineers will shortly begin the publication, under the title of *The Monad*, of a monthly journal to be devoted to matters of direct interest to the engineering profession.

The Iowa Engineering Society will hold its annual convention in Des Moines, Feb. 16, 17 and 18. J. H. Dunlap, secretary, Iowa City, states that it is planned to spend one day at the Iowa State College, Ames.

The Minnesota Surveyors and Engineers Society will hold its annual meeting at St. Paul Feb. 10-12. Prof. F. H. Newell, head of the college of engineering, University of Illinois, will be the speaker of the evening at the annual dinner and smoker, on Feb. 11.

The Louisiana Engineering Society elected the following officers for the ensuing year at the annual meeting held in New Orleans, Jan. 8: President, Samuel Young; vice-president, A. T. Dusenbury; secretary, W. T. Hogg; treasurer, E. H. Coleman; director, Rufus S. Manley.

The Michigan Engineering Society, which met in Grand Rapids Jan. 18, 19 and 20, elected the following officers for the ensuing year: President, George W. Bissell, dean Michigan Agricultural College; vice-president, T. O. Williams; treasurer, A. J. Decker; secretary, S. J. Hoexter, Ann Arbor; directors, L. C. Smith, E. D. Rich and C. T. Johnston.

The Canadian Society of Civil Engineers held a sectional meeting at Montreal Jan. 13. Papers were presented by J. G. Sullivan, chief engineer of the Canadian Pacific Railway, and S. J. Fortin, of the Ottawa department of public works, on the construction of Rogers Pass Tunnel and "The Method Employed in Designing the Foundations of the Federal Palace, Mexico," respectively.

The Engineers' Club of Cincinnati re-elected Frank L. Raschig, principal assistant engineer of the department of public service of that city, president at its annual meeting. Other officers

elected were: Vice-president, A. M. Wilson, professor of electrical engineering, University of Cincinnati; secretary and treasurer, E. A. Gast, bridge engineer, Hamilton County; directors, E. H. Berry, Oscar F. Shepard, Jr., and A. E. Robinson.

The Springfield (Ill.) Engineers' Club entered upon its second year's work by electing Clifford Older, engineer for the Illinois State Highway Commission, president. The club meets on the second Monday night of each month. H. B. Lewis, of the Central Union Telephone Company, Springfield, is the recording secretary and J. R. Hughes, of the State Utilities Commission of Illinois, is corresponding secretary.

The Ohio Engineering Society will hold its annual meeting Feb. 9, 10 and 11 at the Ohio State University, Columbus. Among those who have promised papers are: Clinton Cowen, state highway commissioner; C. E. Sherman, Ohio State University; Thomas J. Smull, Ohio Northern University; Maurice B. Greenough, Case School Applied Science; E. G. Bradbury, W. A. Stinchcomb, H. P. Cumming, C. J. Knisley and F. W. Patterson.

The Association of Engineering Societies, consisting of the Engineers' Club of St. Louis, the Civil Engineers' Society of St. Paul and the Oregon Society of Engineers, has discontinued the publication of its monthly journal. Notice of the disbanding of the association was made in these columns Jan. 1, but the location of its headquarters was noted in a manner that tended to cause some uncertainty as to the constituent societies.

The Harvard Engineering Society of New York will hear Prof. J. B. Woodworth speak on "The First Shaler Memorial Expedition, Notes of a Geological Traveler in Brazil and Chili in 1908-09" at meeting to be held at the Harvard Club, New York City, Jan. 29. The members of the Princeton and Yale engineering associations have been invited to attend. Professor Woodworth went through the "cane country" in lower Brazil, and then across the continent over the Andes.

The Pacific Northwest Society of Engineers held its annual meeting in Seattle, Jan. 8. The following officers were elected for the ensuing year: President, A. S. Downey, consulting and constructing engineer; vice-president, S. B. Hill, consulting engineer; second vice-president, Charles C. More, professor of civil engineering, University of Washington; third vice-president, Jesse A. Jackson, chief computer, office of the city engineer, Seattle; secretary, Harrison A. Taft, contracting engineer; treasurer, W. N. Chase, assistant city engineer, Seattle; librarian, F. W. Allen.

The Indiana Crushed Stone Association elected the following officers for the ensuing year at its annual meeting held at the Claypool Hotel in Indianapolis, Jan. 12-13: President, E. D. Taylor; vice-president, E. T. Milligan; treasurer, V. C. Pogue; secretary, F. W. Connell; directors, O. H. Binns and L. H. Hoblitz. Edward Barrett, state geologist, Charles A. Carruth, of the New York State Highway Department, N. R. Noblet, secretary of the Hoosier Motor Club, and Fred. K. Irvine made addresses at the banquet. Standard specifications for use in improving public roads were adopted by the organization.

The San Francisco Wood Products Association is in the process of formation by A. B. Wastell, who had much to do with the lumber exhibits at the Panama-Pacific Exposition. Its main aim will be the promotion of every possible use of Pacific Coast woods. It will serve as a clearing house for lumbermen's problems, to investigate and counteract false and misleading statements published regarding lumber, to maintain a permanent exhibit of wood products in San Francisco, to advertise lumber throughout California by lectures, moving pictures and portable exhibits and to furnish information to the public regarding wood preservatives, paving blocks and the proper selection and treatment of West Coast timber.

Personal Notes

C. P. RAWSON, office engineer of the Chicago, Milwaukee & St. Paul Railway, has been appointed senior architect in the division of valuation of the Interstate Commerce Commission at Chicago.

SIMON RUSSEK, INC., general contractor, of New York City, has moved its offices from 261 Broadway to 25 Beaver Street.

R. D. RICHARDSON, formerly of the firm of Williams & Richardson, engineers and contractors, of Scranton, Pa., which was dissolved Jan. 1, will continue to supervise the contracts that concern had in hand. He has also opened offices in the Connell Building, Scranton, to carry on a general engineering and contracting business under the name of the R. D. Richardson Construction Company. Mr. Richardson was graduated from the University of Michigan in 1905 and was, for a short period, with the American Bridge Company as a structural draftsman. Later he served with Westinghouse Church Kerr & Company, Post & McCord, the Trussed Concrete Steel Company, and with the bridge department of the Lake Shore & Michigan Southern Railroad. From 1907 to 1911 he was concrete engineer and master mason for the Delaware, Lackawanna & Western Railroad in charge of various works. He became a member of the firm of Williams & Richardson in the latter year. In his new connection, Mr. Richardson will specialize in the design and construction of reinforced-concrete structures.

EDWARD B. CUSHING, formerly chief engineer of construction of the Sunset-Central Lines, has been appointed assistant general manager, with headquarters at Houston, Tex. He was graduated from the Agricultural and Mechanical College of Texas in 1880 and entered railway service as instrument man on the location of the Galveston, Harrisburg & San Antonio Railway. From 1881 to 1883 he assisted in locating and constructing the Mexican International Railroad to Palla, Mexico. From the latter year until 1885 he was again with the Galveston, Harrisburg & San Antonio, as division engineer, and later as contractor of masonry and bridge construction. In 1887 he entered the service of the Gulf, Colorado & Santa Fé as office engineer and chief clerk of construction, and in 1888, attained the grade of engineer of roadway. A year later he went to the Texas & New Orleans and the Galveston, Harrisburg & San Antonio, as resident engineer. In 1897 he became general superintendent of the Houston, East & West Texas and, later in addition to his other duties, was made chief engineer. He entered the service of the Sunset Lines as engineer maintenance-of-way in 1901 and attained the grade of chief engineer of construction in 1908.

MANTON HANNAH, formerly county engineer, on special work, of Lamar County, Tex., has been appointed assistant engineer to Rollen Windrow, county engineer and road superintendent of McLennon County, Tex. Mr. Hannah was graduated from the University of Texas in 1910 and served as superintendent on paving construction for the Shelby-Downard Rock Asphalt Company at Paris, Tex., for a short period, after which he was instrumentman for the Houston & Texas Central Railway until 1911, when he became assistant engineer to J. C. Field, on good roads construction in Grayson County, Tex. Later in the year he was appointed county engineer of Lamar County.

WILLIAM B. GRAY, engineer and contractor, of 2 Rector Street, New York City, has moved his offices to 17 Railroad Avenue, New Rochelle, N. Y., where he will continue his engineering and contracting business, and, in addition, will manage the New Rochelle autobus routes.

ROBERT C. WHEELER, formerly assistant engineer to George W. Fuller, consulting engineer, of New York City, has been appointed city engineer of Summit, N. J. Mr. Wheeler was connected with the staff of George W. Fuller for 5½ years, chiefly on the design, construction and operation of sewers, sewage disposal works and waterworks. His most recent work in that service was as engineer in charge of the construction of the Plainfield joint trunk sewer and sewage disposal works, and of the sewage collecting systems for the boroughs of North Plainfield and Dunellen. Previous to this work he had been assistant engineer on the construction of waterworks and sewers for the city of Clarksburg, W. Va., and resident engineer on the construction of the sanitary sewerage system and sewage disposal works of Vincennes, Ind.

GEORGE W. GARDNER, civil engineer and surveyor, of Madison, N. J., has been appointed borough engineer of that borough. Mr. Gardner will also continue in the private engineering practice he established in Madison about eight years ago.

JOSEPH W. FOOTE, formerly trainmaster for the Erie Railroad at Susquehanna, Pa., has been appointed superintendent of the Delaware Division, with offices in the same city. Mr. Foote entered railway service on the Erie in 1901, and served as acting assistant engineer of the Wyoming division until 1906, when he was appointed assistant engineer on the New York division. In 1908 he became supervisor of the New York, Susquehanna & Western and, in 1910, division engineer of the Allegheny division. He was appointed trainmaster of the Delaware division in 1914.

FRANKLIN B. JAMIESON has been appointed transitman in the office of the engineer maintenance-of-way of the Pennsylvania Railroad. He received his professional education at the Carnegie Technical Schools.

R. W. E. BOWLER, formerly assistant supervisor for the Pennsylvania Railroad at Harrisburg, Pa., has been promoted to the grade of supervisor, with headquarters at South Fork, Pa. He was graduated from Delaware College in 1905, and entered railway service on the Pennsylvania soon after. He was appointed assistant supervisor in 1909.

FREDERIC R. HARRIS, civil engineer, U. S. Navy, has been appointed chief of the Bureau of Yards and Docks, succeeding Homer R. Stanford, whose term expired Jan. 14. Mr. Harris was graduated from Stevens Institute of Technology in 1896, and worked with various contractors along the Atlantic Coast until 1901, when he was appointed assistant engineer for the Rapid Transit Commission of New York City on foundations for elevated structures and on tunnel work. He entered the service of the U. S. Navy in 1902 as chief draftsman of the yard at Charleston, S. C.

R. MCC. BEANFIELD, superintendent of construction for the California State Department of Engineering, has been retained, as superintendent of construction, to complete the Fresno state normal school. The general contractors have abandoned the work and the state is completing it by force account. The structure will be the largest school building in California. The appropriation for it was \$370,000.

J. E. MCINTYRE, formerly supervisor for the Pennsylvania Railroad at Watson-town, Pa., has been appointed supervisor of the Middle division, with headquarters at Mifflin, Pa.

LAWRENCE CONNOLLY has been appointed city engineer to represent the commissions of Jersey City on all municipal construction work. Mr. Connolly is a graduate of Sheffield Scientific School, Yale University.

A. M. WILLIAMS, formerly supervisor for the Pennsylvania Railroad at Titusville, Pa., has been transferred, in the same capacity, to the office of the division engineer at Buffalo.

EARL C. SMITH, formerly assistant supervisor on the Pennsylvania Railroad at Huntingdon, Pa., has been appointed acting supervisor at Titusville, Pa. He was graduated from Lafayette College in 1905, and has been with the Pennsylvania continuously since that time. He was appointed assistant supervisor in 1910.

R. W. BOYD, a New York engineer specializing in structural work, has been appointed secretary to Henry W. Hodge, who was recently made a member of the Public Service Commission for the First District, New York.

A. B. FLETCHER, California State Highway engineer, recently made a reconnaissance of the proposed highway which is to be built by the state from San Bernardino to Needles, Cal. The proposed road will probably be built as far as Barstow under the next bond issue, it is reported, and be carried on to Needles whenever finances permit.

CLARENCE W. MARSH, formerly chief engineer and special investigator for the Hooker Electrochemical Company and the Development & Funding Company, of New York City, has opened offices in the Boston Safe Deposit & Trust Company Building, 201 Devonshire Street, Boston, to engage in practice as consulting and chemical engineer.

JOHN MEIGS, until recently, director of the Department of Wharves, Docks & Ferries of Philadelphia, has opened offices in the Pennsylvania Building, Fifteenth and Chestnut Streets, Philadelphia, to conduct a general consulting and constructing engineering practice. He will give special attention to investigation, valuation, construction and operation of public and private works and industrial plants, including general river, harbor, and port improvements, foundations, bridges, buildings, power plants, water supply, sewerage and pavements. Mr. Meigs was graduated from Columbia University, Washington, D. C., in 1894. Much of his engineering experience has been in the government service, his most recent work in that connection having been the direction of the dredging operations in the Delaware River at Philadelphia, which totaled about \$1,000,000 in cost annually. As assistant engineer in the U. S. Engineer's Office at Washington, D. C., in 1904 and 1905, he was in local charge of the preparation of plans and specifications, and of the construction of the \$1,200,000 Potomac highway bridge and approaches. His first engineering service was as draftsman for the Columbia Railway at Washington, from 1894 to 1895. Following this he was with the Capital Traction Company and the Union Bridge Company. He was appointed junior engineer in the U. S. Engineer's Office in 1897, and surveyor and inspector in the Bureau of Yards and Docks of the Navy Department in 1898. In the latter capacity, he was engaged on the construction of coal storage sheds and unloading piers, and on hydrographic surveys and dredging. He returned to the U. S. Engineer's Office in 1900, and continued in that service until 1906, when he was appointed engineer and superintendent for the Pennsylvania Bridge Company in charge of the construction of various bridges in Washington. From 1907 to 1908 he was engaged as contractor on earth moving and wharf building. In the latter year he returned to the government service as principal assistant engineer, U. S. Engineer's Office, in charge of the dredging work in the Delaware River. He resigned from this office to become assistant director of the Department of Wharves, Docks & Ferries of the city of Philadelphia. He was appointed director of the department in the early part of 1915, and went out of office with the change of local administration this year.

GEORGE R. CAMPBELL, formerly consulting engineer, of Spokane, Wash., and previous to that consulting engineer of bridges and public highways, of Wasco County, Oregon, has been appointed to a position in the office of the U. S. Department of the Interior, at Olympia, Wash., under E. P. Rand, assistant supervisor of surveys for district 8, and E. A. FitzHenry, surveyor general for Washington.

F. S. GATES, formerly assistant supervisor for the Pennsylvania Railroad at Jamesburg, N. J., has been transferred to Huntingdon, Pa., in a similar capacity.

J. V. GIBNEY, formerly transitman in the office of the engineer maintenance-of-way of the Pennsylvania Railroad at Philadelphia, has been promoted to the grade of assistant supervisor in the office of the valuation engineer. He received his professional education at Bucknell University, and entered the service as rodman in the construction department in 1910. He was appointed transitman in the early part of 1915.

F. W. BRUCE has resigned from the office of chief engineer for the Port Commission of Jacksonville, Fla. Mr. Bruce has been identified with the development of Florida since 1884, when he engaged in private practice in St. Augustine, and was appointed city engineer of that city. At the beginning of the late Henry M. Flagler's East Coast hotel construction, Mr. Bruce did all the local engineering and surveying for him. Later he located the St. Augustine & Palatka Railroad, now a part of the Florida East Coast Railroad. For many years he was with the U. S. Engineer Corps on river, harbor and fort repair and construction in the state. He entered the employ of the city of Jacksonville in 1913.

ANDREW R. SMILEY, JR., has been appointed transitman in the office of the engineer maintenance-of-way of the Pennsylvania Railroad. He was graduated from the University of Pennsylvania in 1910.

LOWELL G. KRIGBAUM, of the U. S. Engineer's office at San Francisco, has been sent to Sacramento in charge of the surveys ordered to determine what land will be required by the government in the plan for providing a 15-ft.-depth channel from Sacramento to San Francisco Bay. Mr. Krigbaum will report to Major Rand, in charge of U. S. War Department's investigations in the San Francisco district.

ZENO N. KENT has been promoted from the grade of transitman in the office of the engineer maintenance-of-way of the Pennsylvania Railroad to that of assistant supervisor at Millville, N. J. He was graduated from the Case School of Applied Science in 1910, and entered the service of the Pennsylvania in June of that year. He was appointed transitman in 1915.

H. C. EDDY, formerly engineer of the Public Utilities Commission of the District of Columbia, has been appointed an electrical engineer in the U. S. Navy Department.

CALDWELL & MARSHALL CONTRACTING COMPANY has moved its offices from Lafayette, Ind., where they have been located for nearly two years, to Evansville, Ind. The firm's name has been changed from Caldwell & Drake to the name given above, Clinton B. Marshall having purchased the interest of Mr. Drake. The company has the contract for constructing the new hotel at Evansville, of which H. Ziegler Dietz is architect.

JOHN J. BRACKEN, civil engineer of Newark, N. J., has been appointed town engineer of Harrison, N. J. Mr. Bracken has been engaged in private practice, mainly on municipal work, at Newark since 1902. For the six years previous to that he served on the engineering forces of the Essex County Park Commission.

MAYNARD D. CHURCH has been appointed chief engineer of the Terry Steam Turbine Company, builders of steam turbines for all purposes, of Hartford, Conn.

SYDNEY B. WILLIAMSON has resigned from the office of chief of construction of the U. S. Reclamation Service to become connected with the Guggenheim interests. For the next few months he will be in the New York offices of the firm at 120 Broadway, after which he will go to Chili to take charge of the construction of extensions to the plants at Breden and at Chuquicamata. Previous to his connection with the Reclamation Service, Mr. Williamson was construction engineer with J. G. White & Company, Ltd., of London, England, and, previous to that, was division engineer in charge of the Pacific division of the Panama Canal. He was graduated from Virginia Military Institute in 1884 and, after somewhat over a year as instructor of mathematics at Kings Mountain Military School, was engaged in railroad work until 1890, when he entered private practice at Montgomery, Ala. In 1892 he entered the service of the government on Tennessee River improvement work and remained in that service, with the exception of a short period in Porto Rico as captain of engineers during the Spanish-American War, until 1904, when he went to New York City as designing engineer for the Expanded Metal & Engineering Company. In 1907 he went to the Panama Canal as engineer in charge of the Pacific locks, and, in 1908, was appointed division engineer of the Pacific division. He resigned from the Canal Commission in the latter part of 1912 and went with J. G. White & Company, Ltd. He was appointed chief of construction in the Reclamation Service in December, 1914.

A. F. FISCHER, formerly highway engineer of Jefferson County, Iowa, has been appointed highway engineer for Johnson County, Iowa, to have charge of all highway, bridge and road construction. Mr. Fischer was graduated from the State University of Iowa in 1911 and was in the service of the Delaware, Lackawanna & Western Railroad, in the Buffalo, N. Y., offices, until 1913, when he was appointed city engineer of Clinton, Iowa. He was appointed highway engineer of Jefferson County in 1915.

J. C. ELLIOTT, superintendent of construction of U. S. public buildings, Supervising Architect's Department, Treasury Department, has been relieved from further duty on the post office building at Corry, Pa., and the district adjacent thereto, and assigned to supervise construction of the new federal building at Salamanca, N. Y., and to take care of repairs of buildings at Buffalo and surrounding territory, owned by the Federal Government.

DON L. TEAL, formerly county engineer of Lucas County, Iowa, has been appointed highway engineer of Jefferson County, succeeding A. F. Fischer, whose appointment to another office is noted elsewhere in these columns. Mr. Teal was appointed county engineer of Lucas County in October of last year. Previous to that he was assistant county engineer of Jefferson County.

GEORGE A. MORRIS, engineer for the Litchfield Construction Company on subway work in New York City, died in that city, Jan. 12. For a number of years he was division engineer, middle division, of New York State canals, with headquarters at Syracuse. Prior to that he was engaged on a number of large construction jobs in the South. During his early career he was connected with the Delaware, Lackawanna & Western Railroad on the building of the Buffalo and Cayuga divisions and, later, with Ryan & McDonald. While in these positions he designed, and had charge of the construction of the Susquehanna river bridge at Owego, N. Y. which it was said, was the first large bridge in this country to be built on a curve.

Business Notes

Charles Johnston, formerly sales engineer for the General Fireproofing Company of Youngstown, Ohio, at its Kansas City office, has been transferred in a similar capacity to the Philadelphia office. He is succeeded at the Kansas City office by Mr. J. R. Stalker.

The Association of American Portland Cement Manufacturers has opened offices in the Conway Building, Chicago, and in the Rialto Building, San Francisco. An office is also to be opened in New York. The headquarters of the association will shortly be moved from Philadelphia to Chicago.

The Burton-Townsend Company and the Trimble Paving Brick Company, the first of Zanesville, Ohio, and the second of Dayton, have been added to the Dunn Wire-Cut Lug Brick Company's list of licensees. The Burton-Townsend Company has two plants and a present daily capacity of 160,000 pavers. The Trimble Company has three plants, one at Dayton, one at Trimble, Ohio, and one at Gloucester, Ohio.

Lloyd Brown, who has been handling the Lakewood Engineering Company products at Baltimore, has also opened offices for the company in the Real Estate Trust Building, Philadelphia, and will take care of the trade in New Jersey, Eastern Pennsylvania, Maryland, Virginia and the District of Columbia for the company's entire line of contractors' equipment, concrete mixers, industrial railways, factory, mine and quarry cars and trucks.

E. C. Waldvogel has been appointed general manager of the Yale & Towne Manufacturing Company, manufacturer of chain blocks and electric hoists, locks, hardware, etc., of 9 East Fortieth Street, New York City. Mr. Waldvogel has been connected with the company for the past eleven years as traveling salesman, sales manager and assistant general manager. In addition to the regular duties pertaining to his new office, he will have charge of all sales, domestic, Canadian and export.

J. H. Williams & Company, manufacturer of wrenches and drop forgings, have placed with John W. Ferguson Company of New York and Paterson a contract for several additions to its Buffalo plant, consisting of a 64 ft. by 310 ft. addition to the drop hammer shop and an increase of 82 ft. by 80 ft. to the stock and finishing shop. An entirely new structure will be used as a repair shop. This will be one story, 98 ft. by 62 ft., with a mezzanine floor and a crane runway in the center.

The Virginia Portland Cement Company has announced the retirement of R. W. Kelley, president, Michael Gavin, vice-president, and F. W. White, treasurer, from their respective offices, and the election of Harry C. Trexler, president, E. M. Young, vice-president, and Alonzo F. Walter, treasurer. The main offices of the company will be in the Young Building, Allentown, Pa. The William G. Hartman Company has discontinued the sale and distribution of Old Dominion portland cement, and the Virginia Portland Cement Company, itself, will hereafter sell and distribute its product direct to its customers, under the supervision of B. L. Swett, sales manager.

Obituary Notes

LOREN E. HUNT, principal assistant city engineer of San Francisco, died at his home Jan. 9 at the age of forty-six. Mr. Hunt was a native of Minnesota, from which state he came to California at an early age. He graduated from the University of California and was afterward instructor in civil engineering in the same institution. For some years he was in the engineering department of the United States Forest Service. He served as principal assistant engineer of San Francisco under M. M. O'Shaughnessy for four years.